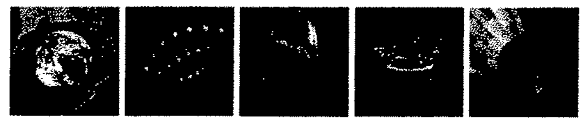


Keystone Steel & Wire Company Endangered Species Evaluation

Prepared for:
Keystone Steel & Wire Company
7000 S.W. Adams Street
Peoria, Illinois

Prepared by:
ENVIRON International Corporation
Atlanta, Georgia

Date:
January 2010

Project Number:
07-21912A

Contents

List of Tables

List of Figures

List of Appendices

List of Acronyms and Abbreviations

AERMET	meteorological preprocessor to AERMOD
AERMOD	Dispersion model used to predict SO_2 concentrations in air
BACT	Best Available Control Technology
C	Celsius
cm	centimeters
D	distance from emission source to receptor
dbh	diameter at breast height
ESA	Endangered Species Act
g	grams
GIS	Geographic Information Systems
ha	hectare
hr	hour
HIS	Habitat Suitability Index
IEPA	Illinois Environmental Protection Agency
km	kilometers
lbs	pounds
LMF	Ladle Metallurgical Furnace
m	meters
mi	miles
NADP	National Acid Deposition Program
NCDC	National Climate Data Center
NMFS	National Marine Fisheries Service
NWS	National Weather Service
pH	measure of acidity or basicity
POI	Point of impingement
PSD	Prevention of Significant Deterioration
s	second
SO_2	Sulfur Dioxide
SO_4	Sulfate
t	time in atmosphere
u	wind speed
UTM	Universal Transverse Mercator
Ton/yr	tons per year
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
WHO	World Health Organization

Executive Summary

This *Endangered Species Evaluation* examines the potential impacts of a proposed incremental increase in SO_2 emissions for the Keystone Steel & Wire facility (Keystone) in Peoria, Illinois. A separate Prevention of Significant Deterioration (PSD) application has been submitted to the Illinois Environmental Protection Agency (IEPA) that evaluated the emission limit increase on visibility, soils and vegetation, and human population growth. On behalf of the United States Environmental Protection Agency (USEPA) Region 5 and the United States Fish and Wildlife Service (USFWS), IEPA requested that an endangered species evaluation be performed to assess the impact of the proposed emission limit increase on threatened or endangered species identified and managed in accordance with the Endangered Species Act (ESA). Therefore, the purpose of this report was to complete an evaluation of the potential adverse impacts of proposed emission increase in SO_2 on four federally threatened or endangered species (receptors) with potentially suitable habitat in the area including the: 1) Indiana bat (*Myotis sodalis*); 2) eastern prairie fringed orchid (*Plantanthera leucophaea*); 3) decurrent false aster (*Bolotonia decurrens*); and 4) lakeside daisy (*Hymenoxys herbacea*). Impacts on the four biological receptors were analyzed over three time scales including two short-term time scales (3 and 24-hr) and one long-term (annual) time scale comparing projected acid fog emission levels with ecological benchmarks. The acid fog analysis was completed using a methodology consistent with an example provided by a USEPA Region 5 representative using weather and pH data from National Acid Deposition Program stations.

Comparing the projected SO_2 emissions levels for all three time scales (3-hr, 24-hr, and annual averaging periods) against the ecological benchmarks indicates no short-term (3-hr and 24-hr) or long-term (annual averaging period) effects are expected on the four biological receptors considered. The acid fog analysis also showed that few observations exceeded the ecological benchmark for low pH levels, that the few observations which did exceed the pH benchmark were of limited duration (1 hr or less), and that the overall proportion of the five-year monitoring period analyzed between 2003 and 2007 that exceeded the pH benchmark were negligible. Therefore, no localized direct effects of acid fog on the plant receptors or indirect effects on the Indiana bat through indirect habitat modification effects are expected.

1 Introduction

Keystone Steel & Wire Company (Keystone) produces steel and wire at a facility in Peoria, Illinois near the Illinois River in Peoria County (Figure 1). In October 2009, Keystone submitted a Prevention of Significant Deterioration (PSD) application to the Illinois Environmental Protection Agency (IEPA) to increase their permitted sulfur dioxide (SO_2) emission limit (ENVIRON 2009a). As part of IEPA's PSD air permitting process, Keystone is required to evaluate potential impacts of the proposed SO_2 emission limit increase. Keystone evaluated the impacts of the emission limit increase on visibility, soils and vegetation, and human population growth in the PSD application. In addition, IEPA has requested that an endangered species evaluation be performed to assess the impact of the proposed emission limit increase on threatened or endangered species identified and managed in accordance with the Endangered Species Act (ESA). U.S. Environmental Protection Agency (USEPA) Region 5 and the U.S. Fish and Wildlife Service (USFWS) oversee the endangered species evaluation on behalf of IEPA. This report evaluates the potential impact of SO_2 emission limit increase on the following federally-listed species for the area: Indiana bat (*Myotis sodalis*), eastern prairie fringed orchid (*Plantanthera leucophaea*), decurrent false aster (*Bolotonia decurrens*), and lakeside daisy (*Hymenoxys herbacea*). This endangered species evaluation was conducted in a manner consistent with the example provided by a representative of USEPA for such assessments in Region 5 (ENVIRON 2009b) for a nearby facility titled the Washington Mills Hennepin, Inc. Endangered Species Evaluation (Cambridge Environmental 2008). For purposes of this report, the project boundary refers to the property boundary.

This endangered species evaluation is organized into several main sections including:

- Section 2 provides an analysis of potential habitats and basic requirements for each federally-listed species,
- Section 3 describes the fate and transport of SO_2 emissions and a conceptual exposure model,
- Section 4 provides an analysis of short-term impacts and the acid fog analysis,
- Section 5 includes the long-term impact assessment,
- Section 6 provides conclusions associated with the endangered species evaluation, and
- Appendix A provides the detailed protocol and method of how the air quality modeling was conducted to estimate the resultant SO_2 concentrations in atmosphere as a result of the projected increase in SO_2 emissions from the facility.

2 Potential Habitats and Basic Requirements of Listed Species

The sections below describe the associated habitats and basic life history requirements for each federally-listed species with the potential to occur within the vicinity of Keystone: the Indiana bat, eastern prairie fringed orchid, decurrent false aster, and lakeside daisy. This section also provides an analysis of potential habitat suitability near the facility based on habitat mapping and makes a determination regarding the likelihood of occurrence based on a combination of information on potential habitat suitability, disturbance, and locations of the nearest known breeding and wintering occurrences of each species.

2.1 Indiana Bat

The Indiana bat is a federally-listed endangered species under the ESA and migratory species. This bat is insectivorous (i.e. eats insects) and requires specific breeding habitat or hibernacula in caves or mines and roost trees (USFWS 2007). The historic winter range of Indiana bats is primarily in the central and eastern U.S. in cave complexes for hibernation. The historic summer range of Indiana bats is less well known and has only been described since the early 1970s and is generally consistent with the current summer range of this species. According to the *First Revision of the Indiana Bat Draft Recovery Plan* (USFWS 2007), known summer locations of the Indiana bat in Illinois occur in the eastern, southern, and western part of the state, but known summer and winter locations are concentrated in one location in the north central part of the state, the southern tip, and the western portion of Illinois. Primary threats to the continued existence of this species includes disturbance, altered microclimate conditions, and vandalism of winter hibernacula sites; and loss and fragmentation of summer and foraging habitat (USFWS 2007).

Suitable winter habitat or hibernacula is one of several key life history requirements along with summer or roosting habitat, and foraging habitat. Beginning in mid July and peaking in late September to October, Indiana bats begin returning to their hibernacula sites for fall mating and to build fat reserves in preparation for winter (USFWS 2007). Individuals typically engage in swarming behavior whereby large number of individual bats enter and exit cave or mine entrances during preparation for hibernation. During this period, the majority of mating occurs before females store sperm over the winter and delay fertilization until the following spring or summer. Females typically have only a single young, so changes in the temperature of the cave or mine that arouse hibernating females and affect fat reserves may have adverse effects on the survival of adult females and their ability to reproduce successfully the following spring. Optimal temperatures are generally lower than 10 degrees Celsius (C°) that avoid prolonged freezes (USFWS 2007).

Suitable summer or roosting habitat varies between males and females and depends on their mating status (USFWS 2007). Beginning in mid April, hibernating bats begin to emerge from their hibernacula and migrate to their summer or roosting sites. Females may migrate short (10 to 60 miles [mi] or 16 to 97 kilometers [km]) or long distances (maximum of 357 mi or 575 km) to potential maternity colonies or roosts and generally arrive within a few days. Less is known about males, but in general they may either remain near the hibernacula or migrate to summer roost sites. Typical maternity colonies and roosts are characterized by the presence of trees with exfoliating bark (e.g. hickory [*Carya* spp.] or oak [*Quercus* spp.] in locations with solar exposure and within close proximity to surface water such as riparian areas, bottomland forests, or other forests near surface water or open areas. Recent improvements on habitat suitability index (HIS) models in the Central Hardwoods Region (including Illinois) predict that suitability increases with the presence of older trees and snags ranging from 17 centimeters (cm) diameter at breast height (dbh) to 50 cm dbh, the presence of open areas or early successional forests, distances less than 4,000 meters (m) to water sources, and direct exposure to solar radiation (Rittenhouse et al. 2007).

Foraging habitat typically includes open areas or surface water bodies within close proximity to summer or roost trees (USFWS 2007). Movement distances of 0.3 mi (0.5 km) to 5.2 mi (8.4 km) are typical for females when moving between summer roost sites and foraging habitat. Indiana bats forage nocturnally after emerging from roost trees and the highest capture rates generally occur in mist nets over surface water bodies where individuals typically fly at elevations greater than 6 feet (ft) (2 m). As summarized in the *First Revision of the Indiana Bat Draft Recovery Plan* (USFWS 2007), Illinois foraging habitat preferences include floodplain forests followed by ponds, old fields, row crops, upland woods, and pastures where individual forage around tree canopies and at the edges of forests or treed corridors.

Potentially suitable habitat for Indiana bats was mapped using land use data from the National Land Cover Database completed by the U.S. Geological Survey (USGS) in 2001. Land cover types were collapsed into several categories including water or wetlands, barren or developed areas, forests, and grasslands or open fields to correspond with the key life history requirements of this species described above using Geographic Information Systems (GIS). The grassland or open field category also included shrubs, hay or pasture lands, and agriculture land cover types. The resulting subset of habitat types is depicted in Figure 2. Water or wetland habitat types (shaded blue) are assumed to provide foraging habitat, forests (shaded green) are assumed to provide roosting and foraging habitat, and grasslands or open fields (shaded light cream) are assumed to provide movement or foraging habitat. Barren or developed areas (shaded brown) are assumed to provide unsuitable habitat.

The results of this analysis indicate habitat areas to the immediate north and east of the site are largely fragmented and composed of barren or developed areas, which is unsuitable habitat. However, to the west, southwest, and south of the site, there are remaining portions of forested habitat surrounded by grassland or open field habitat along the Illinois River that appear suitable.

Information about the location and status of known hibernacula and maternity roosts also provides helpful insight into the possibility of occurrence of this species given the presence of suitable habitat in the region. According to the USFWS, there are no known hibernacula or maternity roosts in Peoria County where the project is located, or the adjacent Tazewell County (USFWS 2007). There are also no known hibernacula or maternity roosts in the surrounding counties including Fulton, Mason, Logan, DeWitt, McLean, Woodford, Marshall, Stork, and Knox Counties (USFWS 2007). The closest known hibernacula is in LaSalle County, approximately 30 mi (48 km) to the northeast where a Priority 2 location is recorded. A Priority 2 category is an index used to estimate the number of positive occurrences or detections since 1995 and represents the category with 1,000 to 9,999 positive detections. According to the Midwestern Region of the USFWS, Peoria and Tazewell Counties are both classified as having the potential for the Indiana bat to occur (USFWS 2009).

On-site habitat conditions provide another useful method for evaluating the potential occurrence of federally-listed species. On-site conditions are highly disturbed with the majority of terrestrial habitat impacted by operations of the Keystone facility. Although there are some surface water bodies on-site that appear to be detention basins, the extent of development is likely to deter individual bats from foraging in the area. An arm of the Illinois River also forms the southern property boundary, but individual bats are unlikely to use this area for foraging due to the intense development associated with operations on-site and in the general vicinity of the industrial area. Given that there are no known hibernacula or maternity roosts on the site or in the nearby counties, is it unlikely that individual bats would occur or regularly use the site or immediately surrounding area. Individual bats may occasionally forage or move along the Illinois River near the site, but they are unlikely to regularly forage or be directly affected by operations on-site.

2.2 Eastern Prairie Fringed Orchid

The eastern prairie fringed orchid (*Platanthera leucophaea* (Nuttall) *Lindley*) is a federally-listed as a threatened plant species under the ESA that occurs in wet (mesic) prairies or semipermanently flooded wetlands in six Midwestern and Great Lakes states in the U.S. (USFWS 1999). The historical distribution of this species in Illinois was widespread prior to European settlement and is now largely confined to several counties around Chicago and other isolated locations in the northwestern portion of Illinois due to reintroduction. The eastern prairie fringed orchid typically occurs on prairie soils in the Wisconsinan Drift physiographic region or sedge meadows in unglaciated regions of Illinois (USFWS 1999). This species required full sunlight for germination and is sensitive to drought and fire during the growing season.

Eastern prairie fringed orchids are a perennial herb that grow from tubers developed underground and flowering stalks that develop from residual growth during the preceding growing season (USFWS 1999). The orchid flowers between June and July for one to two weeks. Reproduction occurs primarily via pollination by several species of nocturnal hawkmoths (*Eumorpha* and *Sphinx* spp.) followed by wind dispersal of the fertilized seed capsules. Eastern prairie fringed orchids are particularly likely to occur in recently disturbed patches when competition is reduced from other plants, but generally only occur in grass or sedge-dominated habitats (USFWS 1999). Potential habitat in Illinois is largely constrained by agricultural development that provides disturbance that is generally not suitable for this species (USFWS 1999).

Potentially suitable habitat for eastern prairie fringed orchids was mapped using land use data from the National Land Cover Database completed by the USGS in 2001. Land cover types that included wetlands or non-permanent water sources (shaded lavender) were identified as suitable habitat and mapped in Figure 3. Open or permanent sources of water (shaded light blue) were also identified for reference to the Illinois River, but this habitat type is not considered suitable. Finally, all other habitats types (barren or developed, forest, and agriculture) were determined to be unsuitable based on the life history requirements of this species.

The results of this analysis indicate suitable habitat is present on and off-site in a relatively wide band along the Illinois River and other narrow and more isolated locations in the surrounding region. Given the high degree of development on-site, this species is highly unlikely to occur within the property boundaries. However, as identified in Figure 3, suitable habitat is mapped off-site in Peoria and adjacent counties, where the USFWS has determined this species has the potential to occur (USFWS 2009).

2.3 Decurrent False Aster

Decurrent false aster (*Boltonia decurrens* (Torr. & Gray)) is a federally-listed threatened perennial plant under the ESA. This plant historically occurred in wetland habitats along sandy floodplains and prairie wetlands along the Illinois River in Missouri and Illinois (USFWS 1990a). This species requires sunlight and may occur in lowland areas that are disturbed to provide adequate light sources for germination and periodically flooded to reduce competition (USFWS 1997a). Extant populations are known to occur in nine counties in Illinois and one county in Missouri. Primary threats are intensive agriculture, changing water control practices such as levees, and siltation along the Illinois River and associated floodplain (USFWS 1997a).

The decurrent false aster reproduces both vegetatively and from seed over at least a two-year period in wild populations (USFWS 1990a). During the first year, basal rosettes form followed by clumps of flowering plants in the second year. Clumps of vegetatively producing plants in Illinois appeared to cease reproducing after four to five years (USFWS 1990a).

Potentially suitable habitat for decurrent false aster was mapped using land use data from the National Land Cover Database completed by the USGS in 2001. Land cover types that included woody wetlands, emergent herbaceous wetlands, and palustrine shrub wetlands (shaded lavender) were mapped as suitable habitat in Figure 4. Open or permanent sources of water (shaded light blue) were also identified for reference to the Illinois River, but this habitat type is not considered suitable. Finally, all other habitats types (developed or barren, forest, grassland, and agriculture) were determined to be unsuitable based on the life history requirements of this species.

The results indicate suitable habitat is present in a band along the Illinois River surrounding the site, as indicated in Figure 4. Potentially suitable habitat is present on-site along an arm of the Illinois River that runs along the southern property boundary. Extant populations in Tazewell County were known as of 1990 and historical populations in Peoria County were also documented (USFWS 1990a). Potentially suitable habitat is also present off-site.

2.4 Lakeside Daisy

The lakeside daisy (*Hymenoxys acaulis* var. glabra) is a federally-listed threatened species. It is a perennial and biennial plant that historically occurred in Illinois, Ohio, and parts of Ontario (USFWS (USFWS 1990b). This species typically occurred on limestone prairie soils, gravel prairies, and alvars (i.e. thin limestone area with thin or no soil and sparse vegetation) in the Great Lakes and Midwest. As of 1990, the only known extant population was in Ottawa County, Ohio. Historical records are known from Manito Prairie Nature Reserve in Tazewell County and the lower Des Plains Valley of Will County, Illinois (USFWS 1990b). No extant populations are currently known from Illinois. Primary threats are limestone quarry activities, livestock grazing, and changing fire regimes that likely constricted the historic range of this species in the Midwest (USFWS 1997b).

Lakeside daisy flowers in late April through early May and reproduces through seed dispersal in mid June (USFWS 1990b). Plants often occur in clumps and may require one to three years before reaching a critical size necessary for reproduction. Pollination may also occur via various bee species (*Bombus* and *Ceratina* spp. or halictids) or wind dispersal. This species also requires outcrossing (i.e. breeding with unrelated individuals) because it possesses the property of sporophytic incompatibility where plants with like alleles are unable to breed successfully (USFWS 1990b).

Potentially suitable habitat for lakeside daisy was mapped using land use data from the National Land Cover Database completed by the USGS in 2001. Grassland land cover types (shaded light cream) were mapped as suitable habitat in Figure 5. Open or permanent sources of water (shaded light blue) were also identified for reference to the Illinois River, but this habitat type is not considered suitable. Finally, all other habitats types (developed or barren, forest, and agriculture) were determined to be unsuitable based on the life history requirements of this species.

The results indicate suitable habitat is present in grassland areas along the Illinois River surrounding the site, as indicated in Figure 5. Extant populations in Tazewell County were known as of 1990 and historical populations in Peoria County were also documented (USFWS 1990b). Potentially suitable habitat is also present off-site.

3 Fate and Transport of Keystone Emissions

The proposed increase in Keystone's emission limit represents a potential increase in SO_2 emissions to the atmosphere (ENVIRON 2009). Table 1 summarizes the projected incremental emissions of SO_2 associated with the emission limit increase from 0.42 pounds (lb) SO_2 per ton of steel to 0.60 lb SO_2/ton of steel .

Table 1 Proposed Increase to the Current SO2 Emission Rate

Chemical of Potential Concern	Proposed Increase in Emission Rate (tons/year)	Proposed Increase in Emission Rate (grams/second)	
		Peak	Annual
SO_2	83	7.42	2.39

Note: Emission rate for SO_2 is based on an increase from current operating emissions to the proposed limit (i.e. 0.42 lb/ton to 0.60 lb/ton)

3.1 Conceptual Exposure Model

A conceptual exposure model representing the exposure pathways and fate and transport of SO_2 and potential direct and indirect pathways for the threatened and endangered receptors considered is shown in Figure 6. Impacts evaluated include time scale or temporal impacts (short and long term) and the type of impact (direct and indirect impacts). Direct impacts are defined as those impacts that result in immediate injury or death to individual plants or animals and indirect impacts are defined as those impacts that may occur at longer time scales, but are reasonably foreseeable following the guidance provided in the USFWS and National Marine Fisheries Service (NMFS) *Endangered Species Consultation Handbook* (USFWS and NMFS 1998). For purposes of this report, direct impacts to plants are considered along with indirect impacts on bats due to potential modification of their habitat from SO_2 emissions. .

As SO_2 is emitted from the facility, these emissions may increase ambient concentrations of SO_2 in the vicinity of the plant and surrounding areas. The resultant SO_2 in the atmosphere may contact water, and when oxidized to SO_4, may decrease the pH of fog or mist. Both increased ambient concentrations of SO_2 and sulfuric acid fog/mist, under highly acidic conditions, may then adversely and directly affect plant receptors due to impaired photosynthesis.

The same two exposure pathways may also have adverse but indirect effects on the Indiana bat because increased ambient concentrations of SO_2 or acid fog/mist, events may adversely and directly affect their roosting habitat (e.g. trees), which may have an indirect effect on individuals and their habitat quality.

3.2 Modeling of Potential Impacts

The modeling of potential impacts of SO_2 on threatened and endangered species involved the use of air dispersion models to estimate SO_2 concentrations and comparison of those estimated concentrations to reference and ecotoxicological benchmarks. The USEPA AERMOD dispersion model was used to predict SO_2 concentrations in air as a result of emissions from the Keystone facility. These predictions were used to determine the significance of the direct and indirect impact of the increase in emissions on the selected receptors. A detailed description of the air modeling method is provided in Appendix A.

The location of potential habitat for threatened and endangered species described in Sections 2.1 through 2.4 were overlaid with a grid in GIS to create a systematic manner of examining receptors. For all three species of plants, a 1,600-hectare (ha) grid with 50-m grid cell spacing was created in areas surrounding the emission sources at the facility for on-site receptors. Potential habitat for off-site receptors outside of the facility was overlaid with a 72,900–ha grid with 100-m grid cell spacing. For the Indiana bat, a 1,600-ha grid with 100-m grid cell spacing was created in the area surrounding the sources of emission at the facility for on-site habitat and a 40,000-ha grid with 500-m grid spacing was created outside the facility for off-site habitat. The receptor grid spacing was set to capture a representative sample of habitat for each species and was slightly different for the Indiana bat than the plant receptors because there was more suitable, which necessitated a reduction in the grid scale to be compatible with AERMOD capacity. The results of overlaying the grid on suitable habitat for each receptor are depicted in Figures 7 through 10.

To determine the potential effect of the emissions on ambient SO_2 levels, the projected facility emissions were modeled using three time scales that included 3-hour (hr), 24- hr, and annual averaging periods to predict SO_2 concentrations at specific ecological receptors. The short-term impact predictions used emission rates determined based on a net difference between the most recent compliance stack testing data showing a current operating emission rate of 0.42 lb SO_2 s/ton of steel , and the proposed limit of 0.60 lb SO_2 /ton of steel . The Keystone operates 24 hours per day (hr/day), so the short-term emission rates (3- hr and 24-hr) were determined from the maximum hourly SO_2 emissions. The long-term impact predictions used annual emissions of SO_2 estimated as 83 tons per year (tpy) or 7.42 grams (g) per second (s) under peak conditions and 2.39 g/s on average. These long-term emission rates were based on a proposed limit of 0.60 lb SO_2/ton of steel and an annual production limit of 820,000 ton/yr. Since Keystone operates 365 days per year, these emissions were divided by 8,760 hours per year to produce an equivalent hourly emission rate.

The results of the dispersion model predictions for SO_2 concentrations at the maximum point of impingement (POI) for both on and off property receptors are summarized in Table 2. Background SO_2 concentrations are from the Peoria Fire Station #8 ambient monitor located at the intersection of McArthur and Hurlbert Roads, and represent average concentrations from 2003 to 2007. The location of the maximum POI on and off property for all three time scales (3-hr, 24-hr, and annual) are depicted in Figure 11.

Table 2 Acute Modeled Increase with Comparisons to Background and Benchmarks for On and Off Property Receptors

Averaging Time[A]	Location of maximum point of impingement with respect to the property line	Projected Increase due to proposed Keystone Expansion (micrograms per cubic meter [µg/m³])	Background Concentration[B] (µg/m³)	Benchmark Protective of Sensitive Vegetation (µg/m³)
3 hours	On Property	523.1	180	786[C]
	Off Property	324.0		
24 Hours	On Property	212.0	61	734[D]
	Off Property	63.5		

A The modeled concentrations taken from the air dispersion modeling represent the second (2nd) highest value for each receptor modeled (i.e., the high 2nd high). The use of these modeled values is consistent with what is required for PSD modeling.

B Data from ambient SO_2 levels collected between 2003 and 2007 at the Ambient Monitoring Station located at Peoria Fire Station #8 at the intersection of MacArthur and Hurlburt Roads (ID: 1430024), Peoria, Illinois.

C USEPA. (1980) A screening procedure for the impacts of air pollution sources on plants, soils, and animals. EPA 45C/2-81-078. Table 3.1, screening concentration values for most sensitive vegetation.

D WHO. 1961. Air Pollution, Effects of air pollution on plants, MD Thomas. WHO Monograph Series. No. 46. WHO Regional Office Copenhagen.

In evaluating the potential effect of the increase in ambient SO_2 levels to result in an increase in acid fog (i.e., decrease baseline pH), the same emission rates were used to predict the short-term (3-hr and 24-hr) impacts. AERMOD modeling predictions were made for 1 hr concentration averaging periods so this data could be directly used in the acid fog analysis. The methods used to make the modeling predictions needed to conduct the acid fog analysis are provided in Appendix A, Sections A.4.3. and A.4.4.

4 Short-term Impacts Assessment

4.1 Short-Term Effects

The evaluation of short term impacts on sensitive plant receptors from SO_2 emissions involves consideration of whether physiological damage or phytotoxicity may occur. For purposes of this report, short term impacts, meaning potential impacts of short duration lasting hours to days (e.g. 3-hr and 24-hr), are considered in further detail below in Section 4.1.1. Longer term effects (e.g., annual emissions) are considered in further detail in Section 5.

Direct impacts to plants may include physiological damage such as leaf damage or death, impaired growth due to reduced photosynthetic ability, and reduced reproduction (USEPA 1981). Bats may also be indirectly affected due to direct impacts on the plants they use for their habitat, such as trees for roosting. As a result, a common approach has to been to develop ecological screening benchmarks that are intended to protect sensitive vegetation and plant communities from potential adverse effects of air emissions. Several important limitations to these ecological screening benchmarks are important to understand including: 1) the species or type of plant (e.g. crop or native species) used for benchmark development; 2) the conditions under which adverse effects were measured (e.g. laboratory or field settings); and 3) the degree to which assessed conditions match the reality of exposure (USEPA 1981). In general, these sources of uncertainty are addressed to the maximum degree possible with ecological benchmarks, such as those proposed here, by using the best available data, results from studies that address the most sensitive of plants using subtle effects, and consideration of multiple time scales for exposure (e.g., 3-hr, 24-hr, and annual averaging periods).

The results shown in Table 2 for both on and off property concentrations of SO_2 at the maximum POI or receptor locations compared to the pertinent ecological screening benchmarks show the proposed incremental increase in projected emissions are below the protective ecological benchmarks for both time scales associated with acute effects (3-hr and 24-hr averaging periods). The worst case scenario or maximum impacts described in Table 2 also indicate projected emissions of SO_2 during the 3-hr averaging period are roughly three times background concentrations, and that the 24-hr averaging period projections are roughly four times background concentrations. Figure 11 indicates the spatial location of the 3 hr averaging period maximum concentrations are located in the center of the property for on property receptors and slightly west of the property for off-property receptors. The locations of the 24-hr averaging period maximum concentrations also show the on property receptor in the center of the property and the off property receptor slightly to the southwest of the property. Collectively, these results indicate the projected increase in SO_2 emissions is not expected to adversely affect the threatened and endangered species considered in this endangered species evaluation.

4.2 Acid Fog/Mist Analysis

To address acute local impacts, ENVIRON evaluated the potential for emissions of gaseous SO_2 at the Keystone facility to decrease the pH of fog and mist to levels that will adversely affect sensitive species. The methodology for evaluating SO_2 for Keystone is consistent with to the one described for addressing SO_2 in *Washington Mills Hennepin* (WMH), *Inc. Endangered Species Evaluation* (Cambridge Environmental 2008),. The following sections describe the methodology used and results of the analysis.

Integrated Surface Data from the National Climate Data Center (NCDC) was compiled from weather observations from the Peoria Airport weather station (U.S. Air Force 72530) over a five-year period from 2003 – 2007. Data from the NCDC was used in the 3505 format with observations recorded at irregular intervals with spacing between 6 and 60 minutes per observation depending on weather patterns. The 3505 data format includes three columns per observation period that allow the observer to describe the current weather conditions using two digit codes. Observation codes 11-12 and 40-49 denote various types of fog or ice fog, and observation code 10 denotes mist. The observations were processed so that the irregularly spaced weather observations could be linked directly to the regularly spaced hourly SO_2 concentrations output by AERMOD. If any observations within an hour contained one of the fog codes or the mist code, that hour was flagged for further analysis. Every hour in the period from 2003 – 2007 was designated as either: no fog/mist, fog only, mist only, or combined fog/mist.

For this analysis, fog is defined as limiting visibility to less than 1 km; whereas, mist is defined as limiting visibility to less than 2 km. The definition based on visibility relates to the density of water droplets in air. Fog limits visibility to a greater degree because more water is present. In the WMH example regarding the impacts of SO_2 emission on the pH of fog/mist, fog was defined as a concentration of approximately 0.1 mL/m^3, whereas mist was approximately 0.01 mL/m^3.

The designation of each hour as a fog or mist observation is important because the predicted concentration of SO_2 in air will cause a greater decrease in pH during mist events compared to fog events. In cases where it was not clear whether the hour should be defines as a fog or mist event (the observer reported both fog and mist in the same observation and or there are sub-hourly observations within the same hour that are designated as both fog and mist), these hours were treated as mist events which results in a conservative assessment of impacts on pH.

Using the AERMOD dispersion model, ENVIRON estimated the SO_2 concentrations for each hour at the maximally impacted receptor during fog, mist, and fog/mist combined events during the growing season over the five-year period (May to September). As described above, fog/mist observations may have been recorded on intervals ranging from every 6 min to an hr. In order to preserve as much accuracy as possible within the analysis, 1-hr SO_2 concentration predictions were made in AERMOD because this is the shortest averaging period available within the program. The analysis of acid fog relies on modeling the conversion of the gaseous form of SO_2 to the aqueous and acidic sulfate ion (SO_4^{2-}). The final metric assessed for the acid fog analysis is the frequency at which the pH drops below critical levels, the duration of those periods, and the overall percentage of the five-year observation period characterized by critically low pH conditions.

4.2.1 Fog History

The most common source of detailed weather observations are typically large airports. The nearest airport to the Keystone facility is located approximately 2.5 mi northwest of the facility and is expected to have similar climate patterns to those occurring at the Keystone facility. The weather data used from the Peoria Airport weather station is expected to provide a reasonable estimate of the projected relationship between weather conditions and elevated SO_2 because it was also used to provide meteorological inputs for the AERMOD dispersion calculations. The relationship between weather and SO_2 is subsequently expected to have a reasonable relationship between high sulfate and low pH fog, mist, or combined fog/mist events, which may be associated with adverse ecological effects. Therefore, the inclusion of the five-year weather and meteorology data set is designed to provide a representative snapshot of conditions surrounding the Keystone facility.

Ecological risk for sensitive receptors is driven by the time of year that acid fog, mist, or combined fog/mist events may occur in relation to critical growth and reproduction periods and the time of day that the same conditions may occur. The time of year, such as the growing or reproductive season for plants, is important because they are dormant and not active during many other parts of the year, when risk of exposure may be minimal. Therefore, this endangered species evaluation focuses on the growing season defined as May to September, because this is the time of year that most plants are active, especially at northern latitudes. Therefore, dispersion modeling predictions focused on SO_2 concentrations during the growing season only.

Time of day is also important because local atmospheric conditions are highly variable and may not have uniform effects when transpiration and other normal plant processes are also variable. AERMOD uses meteorological information to estimate parameters that affect dispersion on an hourly basis. As stated above, weather observations were collected at intervals between 6 min and an hr. The combined level of detail provides a reasonable approximation of the daily variability.

The results of the acid fog history analysis from the Peoria Airport weather station over the five-year observation period by time of year and time of day during the growing season are shown in Figures 12 and 13, respectively. During the growing season (May to September) in the same five-year period, there was a general trend of declining amounts of observations where fog only, mist only, or a combined fog/mist event were recorded. Approximately 0.5% of the hours during the growing season were associated with fog, 5.7% were associated with mist, 4.8% were associated with a combined fog/mist event, and a total of 11 % of the hours were associated with either fog, mist, or a combined fog/mist event.

4.2.2 The Acid Fog Model and determination of the Maximally Impacted Receptor

In order for the emission of SO_2 gas to cause a decrease in the pH of fog, it must dissolve in the water and be oxidized to sulfate (SO_4^{2-}) (Cambridge Environmental 2008). The decrease in pH of fog at any location is dependent on the concentration of SO_2 in air, the amount of that gaseous form ($SO_{2\,(g)}$) that is dissolved in water ($SO_{2\,(aq)}$), and the amount of that aqueous concentration that is converted to sulfate (SO_4^{2-}). The chemical equation below shows a potential stepwise conversion mechanism:

$$SO_{2(g)} \xrightarrow{k_1} SO_{2(aq)} + oxidizers \xrightarrow{k_2} SO^{2-}_{4(aq)}$$

The conversion rate constant, k_1, is related to the solubility of $SO_{2(g)}$ in water, while k_2 is dependent on the rate of the oxidation reactions available and the mass of oxidizing reagents available. Separating these reactions is difficult, and does not provide additional insight for the purpose of acid fog analysis. The overall reaction rate can be estimated by assuming that $1/k = 1/k_1 + 1/k_2$. In the WMH example provided by the USEPA, the value of the lumped conversion rate constant was determine to be k = 10% / hr, based on their literature review (Cambridge Environmental 2008), where all $SO_{2(g)}$ was assumed to be dissolved in the moisture of a fog/mist event immediately, ($k_1 \rightarrow \infty$) and oxidization to sulfate ($SO_{4(aq)}$) is the rate limiting step ($k=k_2$). The USEPA's suggested method uses the conversion rate constant in a first order linear approximation to calculate the concentration of SO_4^{2-}, where:

$$[SO^{2-}_{4(aq)}] = [SO_{2(g)}] * (1 - e^{-kt}) \left(\frac{1000(mL/L)}{10^6(\mu g/g) * 64.07(g/mol) * \rho_{fog/mist}(mL_{H_2O}/m^3_{air})} \right), \text{where } t = \left(\frac{d}{u}\right)$$

The residence time in the atmosphere in seconds (t) is defined as the distance from the emission source to the receptor in m (d) over the wind speed in m per second (u) during the fog/mist event.

Based on the above equations, it is important to note that both the SO_2 concentration in atmosphere and the contact time (which increases with distance from the source to receptor) are critical factors in the determination of the maximally impacted receptor; and both factors are independent and inversely proportional. In other words, for receptors that are very close to the source the SO_2 concentrations are higher, however the contact time would be very low ($d,t \rightarrow 0$).

For this assessment, the location of the maximally impacted receptor was therefore identified by the use of the decay option in the AERMOD dispersion model to incorporate both SO_2 concentration and contact time when identifying the maximally impacted receptor. This method required two model runs with identical sources, receptors, and meteorological data and is described in more detail in Appendix A, Section A.4.3.

A decay rate of 17.3%/hr was used because this was the default suggested by the value provided by the USEPA for SO_2 decay in air. This value represents a 4 hr half life.

Figure 14 shows the location of the maximally impacted receptor.

4.2.3 Hourly Sulfate Predictions at the Maximally Impacted Receptor

The worst case decrease in pH as a result of increased SO_2 emission from the Keystone facility was evaluated using hourly predictions of the concentration of SO_2 at the maximally impacted receptor with the weather data.

The decrease in pH at the maximally impacted receptor is based on the concentration of SO_2 in air, the amount that dissolved and is converted to sulfate (SO_4^{2-}) in fog/mist, and the volume water in air. Using the methodology described in Appendix A, Section A.4.4, the hourly concentrations of SO_2 at the maximally impacted receptor for every hour during the growing season over the period from 2003 – 2007 were predicted. The equation below shows the calculation used to predict the concentration of sulfate in fog/mist:

$$[SO_{4(aq)}^{2-}](mol/L) = \left([SO_{2(gas)}]_{\mathrm{MaximallyImpactedReceptor}}(\mu g/m^3)\right)\frac{1000(mL/L)}{10^6(\mu g/g) * 64.07(g/mol) * \rho_{fog/mist}(mL_{H_2O}/m_{air}^3)}$$

4.2.4 Background pH Determination

The background pH of the fog/mist event was determined using the lowest pH measured at National Acid Deposition Program (NADP) stations in the area. The stations active from 2003 – 2007 in the area were Shabbona, Monmouth, and Bondville. The locations of the NADP stations surrounding the site are shown in Figure 15. Bondville experienced the lowest lab-measured pH during the period (pH = 3.56), which was used as the background for all fog/mist events. The frequency of observation of each of the pH values are shown in Figure 16. The pH is presented as a function of the amount of precipitation measured in Figure 17. Extreme high and low pH measurements occur during periods of low precipitation, such as would occur during fog, mist, or very light rain, however not all low precipitation measurements have extreme pH. This illustrates two points:

- low pH is linked to the presence of high concentrations of SO_2 in atmosphere and fog/mist events; and
- it is possible that not all fog/mist events occur when there are high concentrations of SO_2 in atmosphere.

4.2.5 Worst-Case Modeled Acid Fog pH

According to the (USEPA 1991), pH levels between 1.6 and 2.6 have been associated with adverse direct effects on plants. Therefore, a pH value of 2.6 was used to represent conditions under which acid fog may adversely affect plant receptors. The cumulative amount of time that acid fog with pH values less than 2.6 occurred, the individual duration of those events, and the total cumulative amount of time with pH values less than 2.6 during the five-year observation period were used to assess the effects of acid fog.

Predicting the pH of fog or mist after the addition of SO_4 as a result of the emission increase from Keystone (pH_{post}), requires the background or pre-existing pH value determined in the preceding section ($pH_{backgournd}$ = 3.56). For all the hours with observations of fog/mist the predicted pH was calculated as:

$$pH_{post} = -\log\left(2 * [SO_{4(aq)}^{2-}] + 10^{pH_{background}}\right)$$

The predicted 1-hr average pH for hours that contain observations of fog, mist, and combined fog/mist are shown in Figure 18. There were 18,360 hrs assessed during the growing season. Of that total number, there were 86 hrs where fog only was observed, and only one case where pH dropped by more than 0.01 units. None of the fog only hrs hours were associated with pH values less than 2.6 as the lowest predicted value was 3.48. For the hours designated as mist and combined fog/mist, there were 14 hrs predicted to have a pH below the threshold of 2.6, 10 hrs during mist events and 4 hrs during combined fog/mist. It is likely that the predicted pH values during the 4 combined fog/mist hrs are overly conservative, because the density of water in air for mist was used to calculate pH. The 14 hrs below the threshold identified represent 0.5 % of the hours where an observation of fog/mist occurred and approximately 0.08 % of the entire growing season.

There are often consecutive hours with observations of fog/mist, which should be grouped to form a single event. In order to assess these longer duration impacts, event-averaged pH values for all fog only, mist only, or combined fog/mist events during the growing season at the maximally impacted receptor location were predicted and are shown in Figure 19. The results indicate that only a single event is predicted where the ecological benchmark of pH values less than 2.6 is exceeded, and the duration of this single event is 1 hr. This means that the other thirteen 1-hr predictions of pH below 2.6 are preceded or followed by more moderate pH. The event-averaged pH approach is likely more representative of how sensitive species will experience the shift in pH in the natural environment (i.e., it is unlikely that the pH will shift abruptly from as that that would be depicted).

Collectively, these results indicate very limited potential for impacts on sensitive plant receptors as a result of the proposed increase in SO_2 emissions from the Keystone facility. Given such limited potential exists for impacts to sensitive plants, no unacceptable risks are expected for Indiana bat habitat.

5 Long-term Impacts Assessment

Long-term effects are those effects that may occur at lower concentrations but over longer time scales such as months and years. Therefore, the estimate of annual emissions of SO_2 in the dispersion model was used to predict a concentration of SO_2 in air for comparison to background levels, and ecological benchmark concentrations to determine the potential for chronic effects on threatened and endangered species receptors or their habitats considered in this endangered species evaluation.

The projected annual emissions of SO_2 in comparison to local background concentrations are presented in Table 3. These results show that the projected incremental increases are still below local background concentrations for the area and below recommended ecological benchmarks established by the World Health Organization (WHO) (1961). Therefore, no long-term impacts on threatened and endangered species receptors are expected for Indiana bats or any of the plant species.

Table 3 Chronic Modeled Increase with Comparisons to Background and Benchmarks for On and Off Property Receptors

Averaging Time	Location with respect to Property Line	Projected Increase due to proposed Keystone Expansion (µg/m^3)[A]	Background Concentration[B] (µg/m^3)	Benchmark Protective of Sensitive Vegetation[C] (µg/m^3)
Annual	On Property	8.21	11	20
	Off Property	1.83		

[A] The modeled concentrations taken from the air dispersion modeling represent the highest value for each receptor modeled (i.e., the high 1st high). The use of these modeled values is consistent with what is required for PSD modeling.

[B] Data from ambient SO2 levels collected between 2003 and 2007 at MacArthur and Hurlburt station (ID: 1430024), Peoria, Illinois.

[C] For natural and forest vegetation: WHO. 2000. Air Quality Standards for Europe. Second addition. WHO Regional Publications, European Series. No. 91. WHO Regional Office. Copenhagen.

6 Conclusions

An endangered species evaluation was completed to evaluate the potential impacts of the proposed emission increase of SO_2 at the Keystone facility at Peoria, Illinois on four federally-listed species regulated by the ESA including the: 1) Indiana bat; 2) eastern prairie fringed orchid; 3) decurrent false aster; and 4) lakeside daisy. Comparing the projected SO_2 emissions levels for all three time scales (3-hr, 24-hr, and annual averaging periods) against the ecological benchmarks indicates no short-term (3 and 24 hr) or long-term (annual averaging period) effects are expected on the four biological receptors considered. The acid fog analysis also showed that few observations exceeded the ecological benchmark for low pH levels, that the few observations which did exceed the ph benchmark were of limited duration (1 hr or less), and that the overall proportion of the five-year monitoring period analyzed between 2003 and 2007 that exceeded the pH benchmark were negligible. Therefore, no localized direct effects of acid fog on the plant receptors or indirect effects on the Indiana bat through indirect habitat modification effects are expected.

7 References

Cambridge Environmental. 2008. Washington Mills Hennepin, Inc. Endangered Species Evaluation.

ENVIRON 2009a. Keystone Steel & Wire Prevention of Significant Deterioration (PSD) Application for Sulfur Dioxide Limit Increase.

Rittenhouse, C. D, W. D. Dijak, F. R. Thompson III, and J. J. Millspaugh. 2007. Development of Landscape-Level Habitat Suitability Models for Ten Wildlife Species in the Central Hardwood Region. U.S. Forest Service General Technical Report NRS-4. Northern Research Station.

ENVIRON 2009b. Personal communication from Rachael Rineheart (USEPA Region V) and Suzanne Scribner on March 26, 2009.

USFWS. 1990a. Decurrent False Aster (*Boltonia decurrens* (Torr. & Gray)) Recovery Plan. USFWS Region 3, Twin Cities, Minnesota. September 28. Accessed at: http://ecos.fws.gov/docs/recovery_plan/900928c.pdf

USFWS. 1990b. Lakeside Daisy (*Hymenoxys acaulis* var. glabra) Recovery Plan. USFWS Region 3, Twin Cities, Minnesota. September 19. Accessed at: http://ecos.fws.gov/docs/recovery_plans/1990/900919b.pdf

USFWS. 1997a. Decurrent False Aster Fact Sheet. USFWS Region 3, Fort Snelling, Minnesota. Accessed at: http://www.fws.gov/midwest/endangered/plants/pdf/d-f-aster.pdf

USFWS. 1997b. Lakeside Daisy Fact Sheet. USFWS Region 3, Fort Snelling, Minnesota. Accessed at: http://www.fws.gov/midwest/endangered/plants/pdf/ls-daisy.pdf

USFWS. 1998. Endangered Species Consultation Handbook. USFWS and NMFS. March.

USFWS. 1999. Eastern Prairie Fringed Orchid (*Platanthera leucophaea* (Nuttall) Lindley) Recovery Plan. USFWS Region 3, Fort Snelling, Minnesota. September 29. Accessed at: http://www.fws.gov/midwest/endangered/plants/pdf/epfoplan.pdf

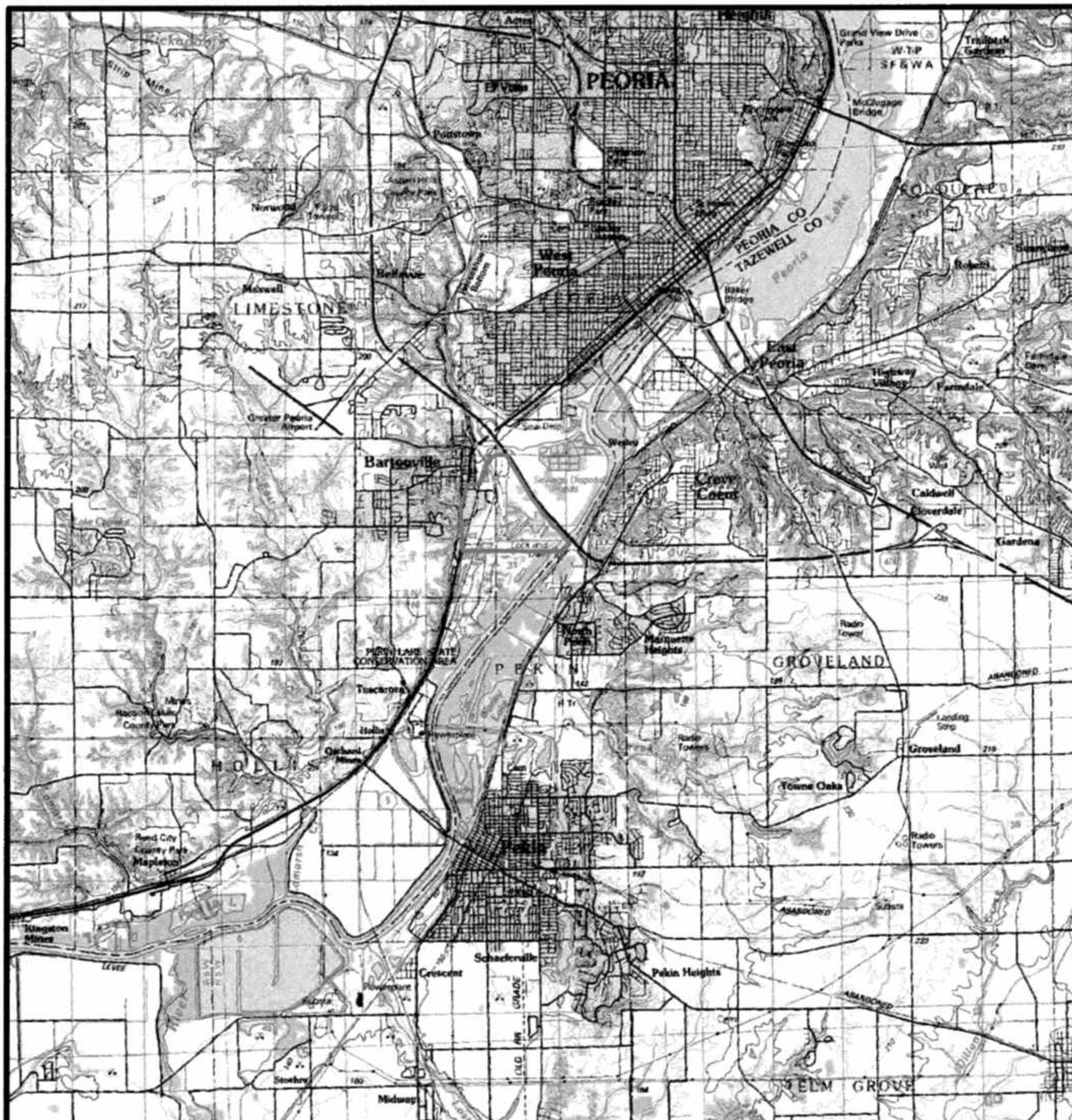
USFWS. 2005. Eastern Prairie Fringed Orchid Fact Sheet. Chicago, Illinois Field Office. Barrington, Illinois. Accessed at: http://www.fws.gov/midwest/endangered/plants/pdf/epfo-cifo.pdf

USFWS. 2007. Indiana bat (*Myotis sodalist*) Draft Recovery Plan: First Revision. April. USFWS Region 3, Fort Snelling, Minnesota. Accessed at: http://www.fws.gov/midwest/endangered/mammals/inba/inba_drftrecpln16ap07.html

USFWS. 2009. Illinois List of Federally Endangered, Threatened, Proposed, and Candidate Species By County. Updated February. Illinois Field Office, Moline, Illinois. Accessed at: http://www.fws.gov/midwest/endangered/lists/illinois09cty.pdf on July 30, 2009.

USEPA. 1991. National Acid Precipitation Assessment Report, Acidic Deposition: State of Science and Technology, Volume III: Terrestrial, Materials, Health and Visibility Effects. Effects of Pollutants on Vegetation, p. 18-124.

Appendix Figures



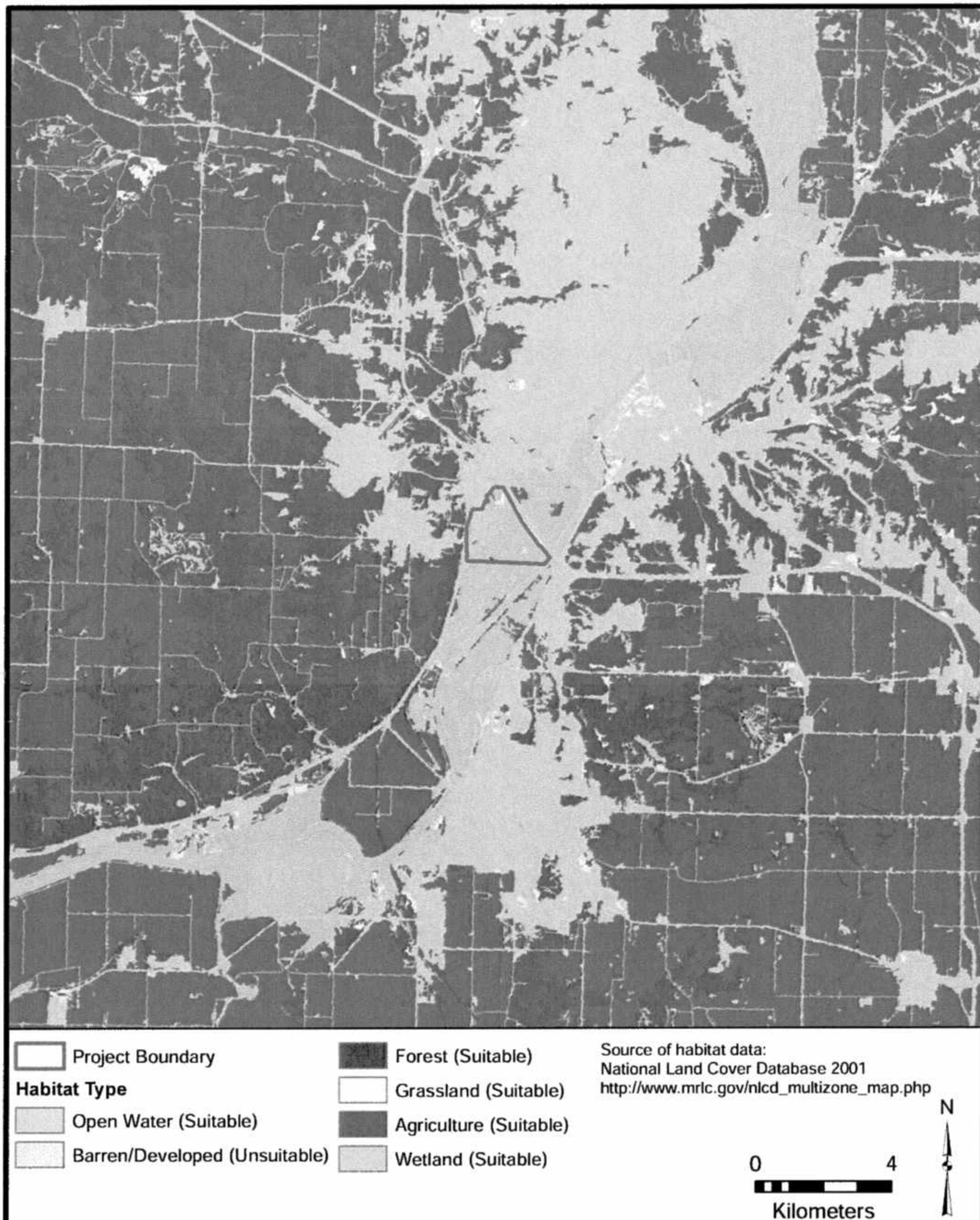
Project Boundary

Source of topographic map: USGS Digital Raster Graphic
Peoria quadrangle 1:100000 scale
downloaded from the Illinois Natural Resources Geospatial
Data Clearinghouse http://www.isgs.illinois.edu/nsdihome/webdocs/drgs/

0 1 2 4
Kilometers

N

ENVIRON	Site Map	Figure 1

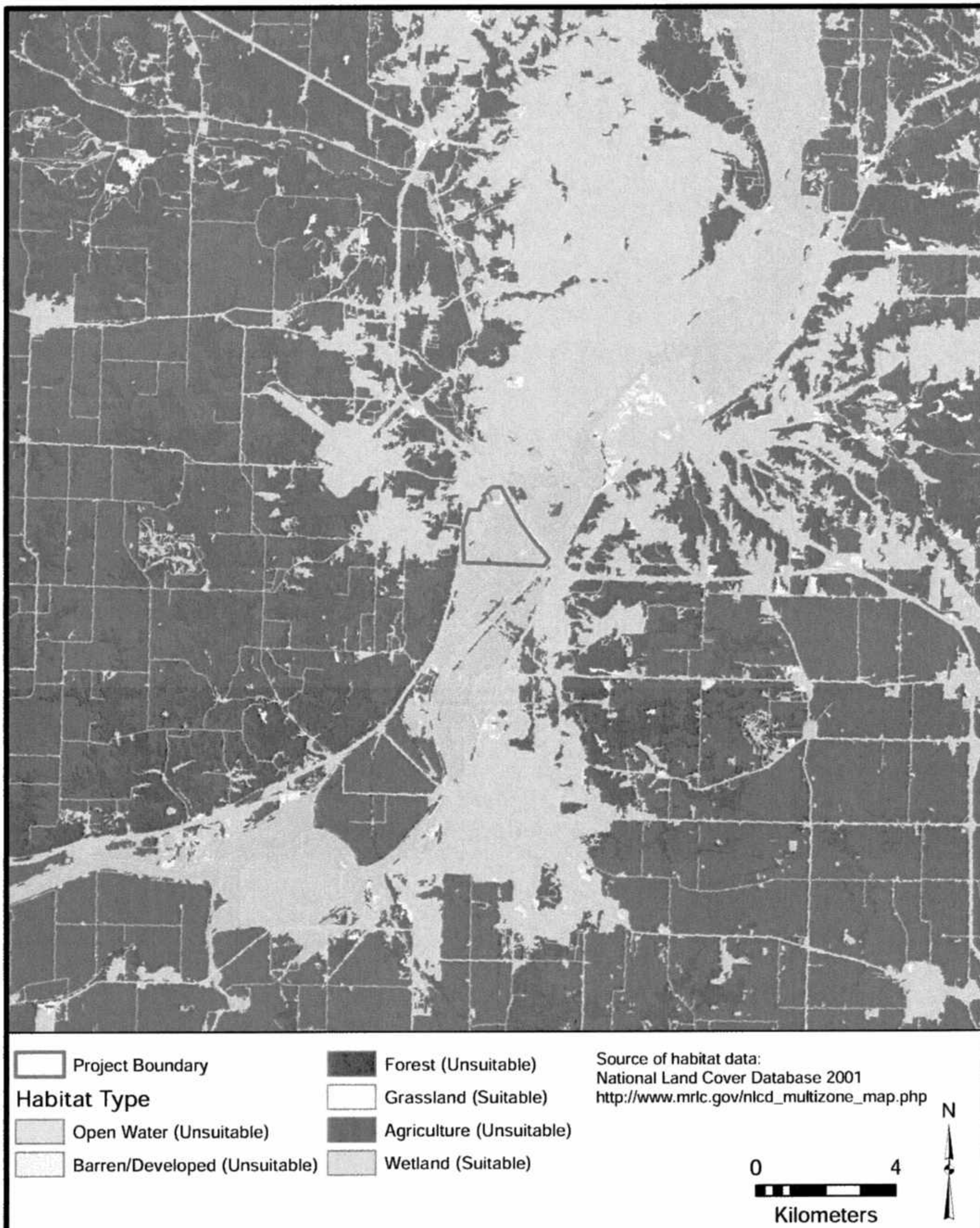


ENVIRON

Potential Indiana Bat Habitat

Figure 2

Tuesday, November 17, 2009 11:05:45 AM
\\mesrv02\Client_Files\Keystone\GIS\MXD\IndianaBat_Final.mxd



ENVIRON

Potential Eastern Prairie Fringed Orchid Habitat

Figure 3

Tuesday, November 17, 2009 11:33:24 AM
\\mesrv02\Client_Files\Keystone\GIS\MXD\EasternPrairieFringedOrchid_Final.mxd

Project Boundary

Habitat Type

Open Water (Unsuitable)

Developed/Barren (Unsuitable)

Forested (Unsuitable)

Grassland (Unsuitable)

Agriculture (Unsuitable)

Wetland (Suitable)

Source of habitat data:
National Land Cover Database 2001
http://www.mrlc.gov/nlcd_multizone_map.php

N

0 4

Kilometers

ENVIRON

Potential Decurrent False Aster Habitat

Figure 4

Tuesday, November 17, 2009 11:15:44 AM
\\mesrv02\Client_Files\Keystone\GIS\MXD\DecurrentFalseAster_Final.mxd

Project Boundary

Habitat Type

Open Water (Unsuitable)

Barren/Developed (Unsuitable)

Forest (Unsuitable)

Grassland (Suitable)

Agriculture (Unsuitable)

Wetland (Unsuitable)

Source of habitat data:
National Land Cover Database 2001
http://www.mrlc.gov/nlcd_multizone_map.php

0 4
Kilometers

N

ENVIRON

Potential Lakeside Daisy Habitat

Figure 5

Tuesday, November 17, 2009 11:25:01 AM
\\mesrv02\Client_Files\Keystone\GIS\MXD\LakesideDaisy_Final.mxd

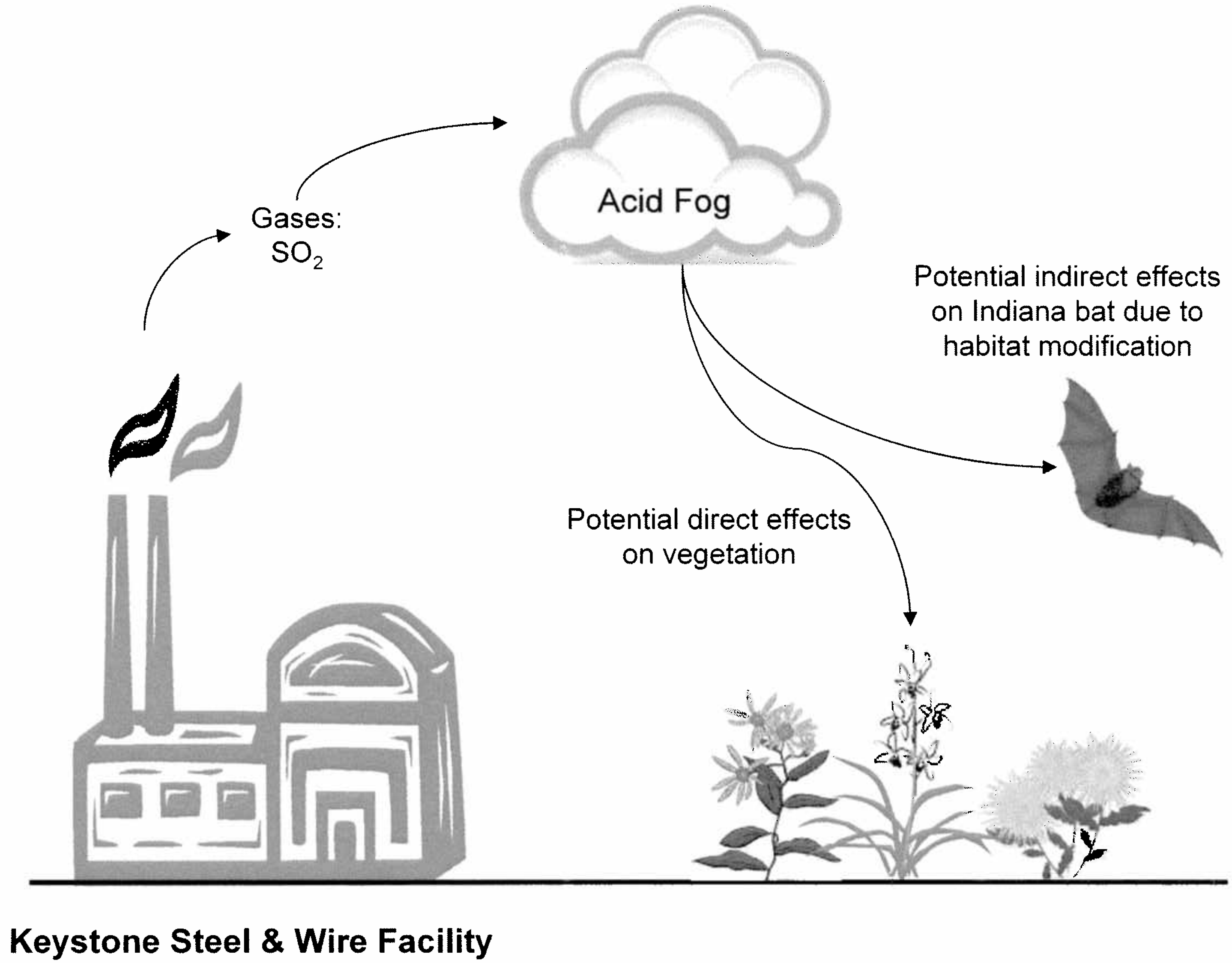


Figure 6. Conceptual exposure model showing the fate and transport of Keystone emissions

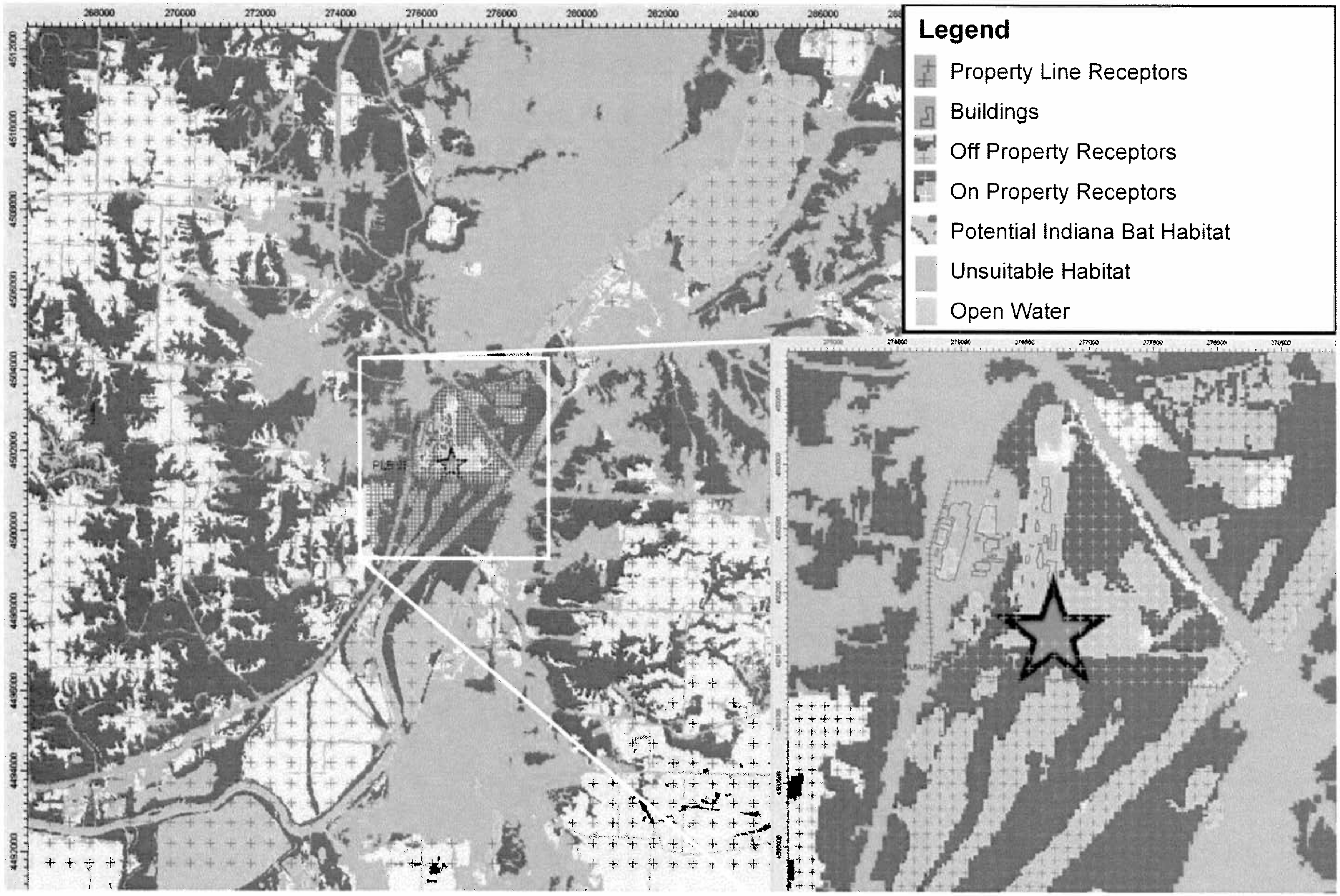


Figure 7 – Potential Indiana Bat Habitat with Receptors Overlaid

Note: Some areas of the site shown as open water are, upon review of current aerial photographs, buildings, roadways, and parking areas

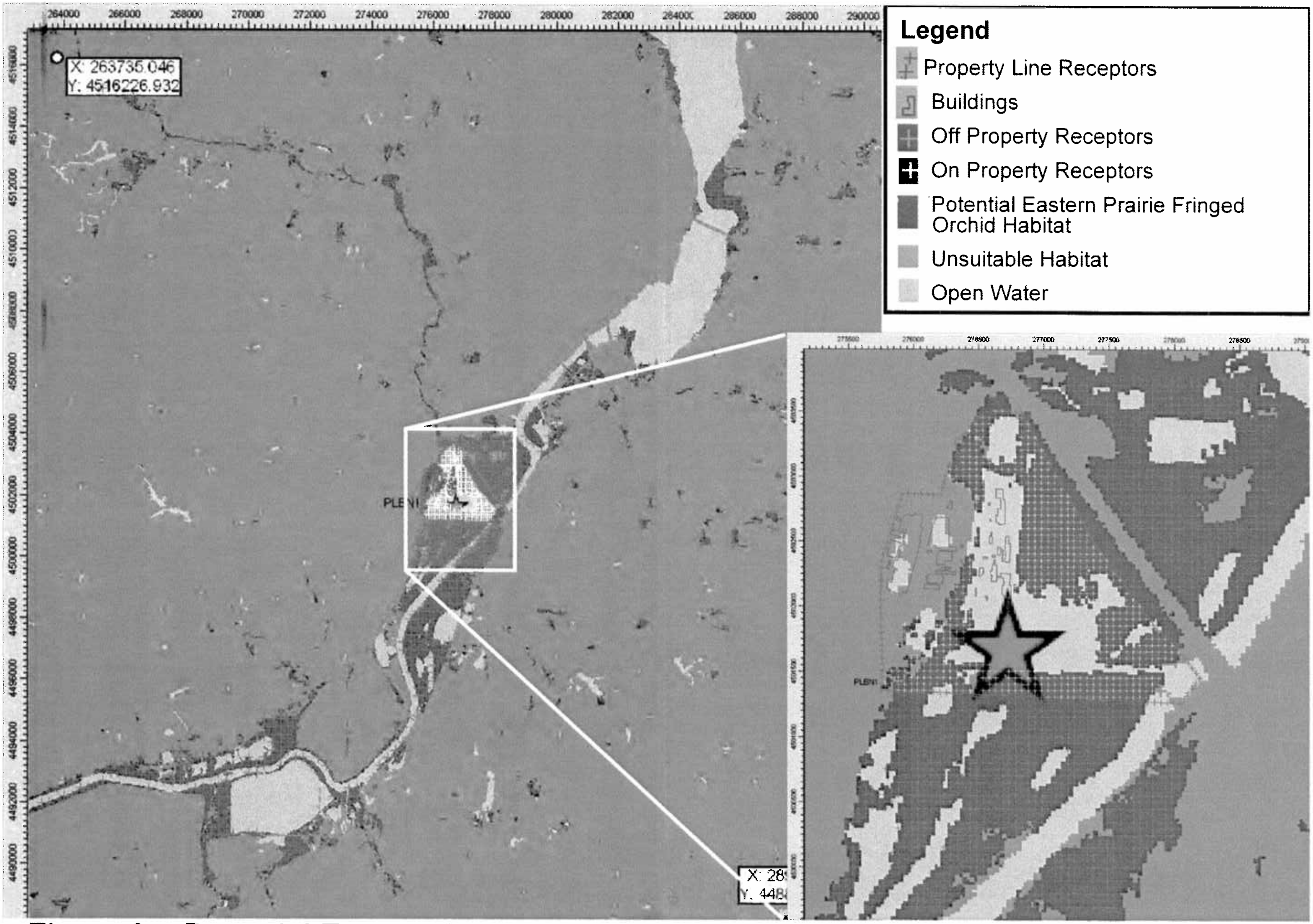


Figure 8 – Potential Eastern Prairie Fringed Orchid Habitat with Receptors Overlaid

Note: Some areas of the site shown as open water are, upon review of current aerial photographs, buildings, roadways, and parking areas

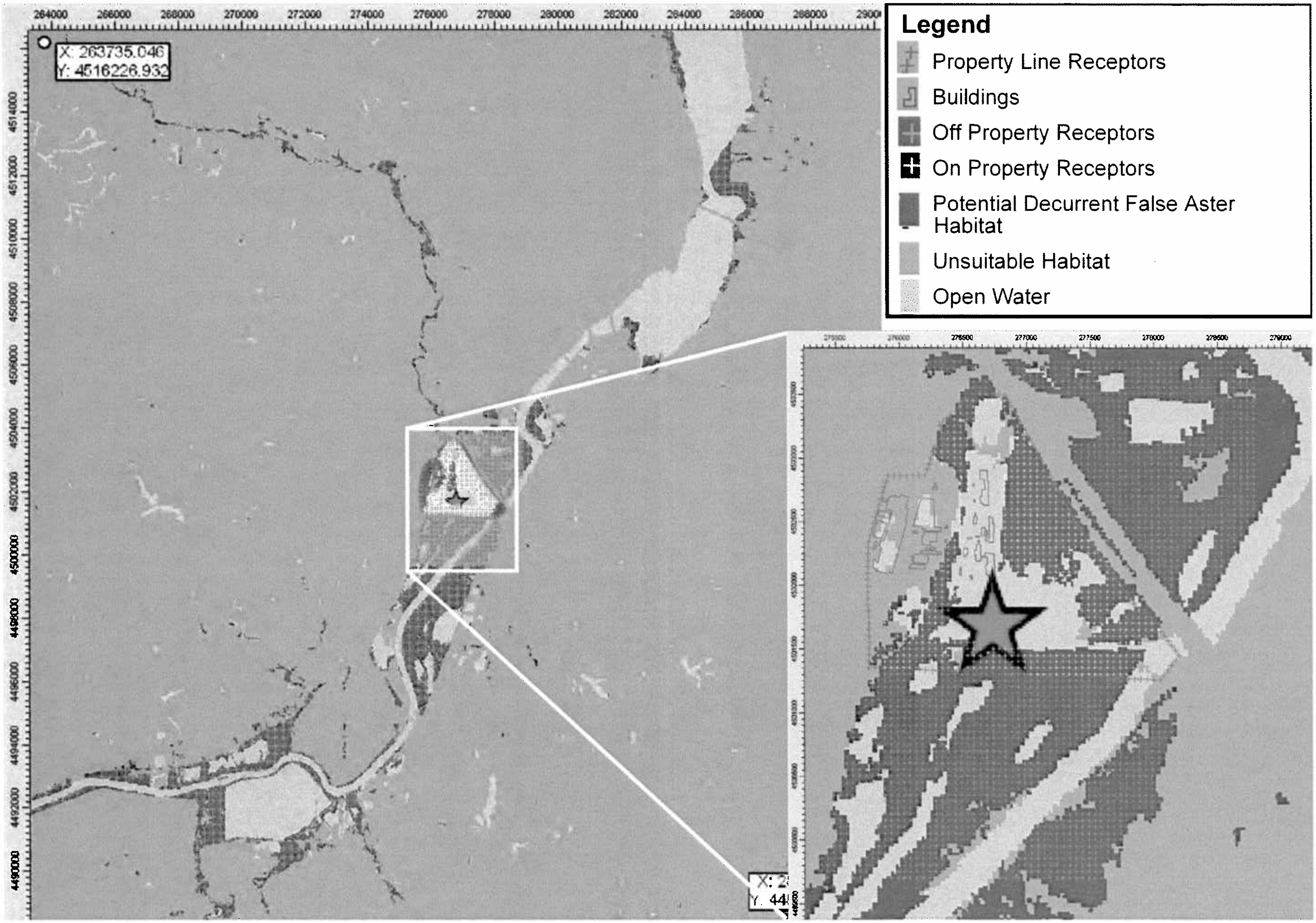


Figure 9 – Potential Decurrent False Aster Habitat with Receptors Overlaid

Note: Some areas of the site shown as open water are, upon review of current aerial photographs, buildings, roadways, and parking areas

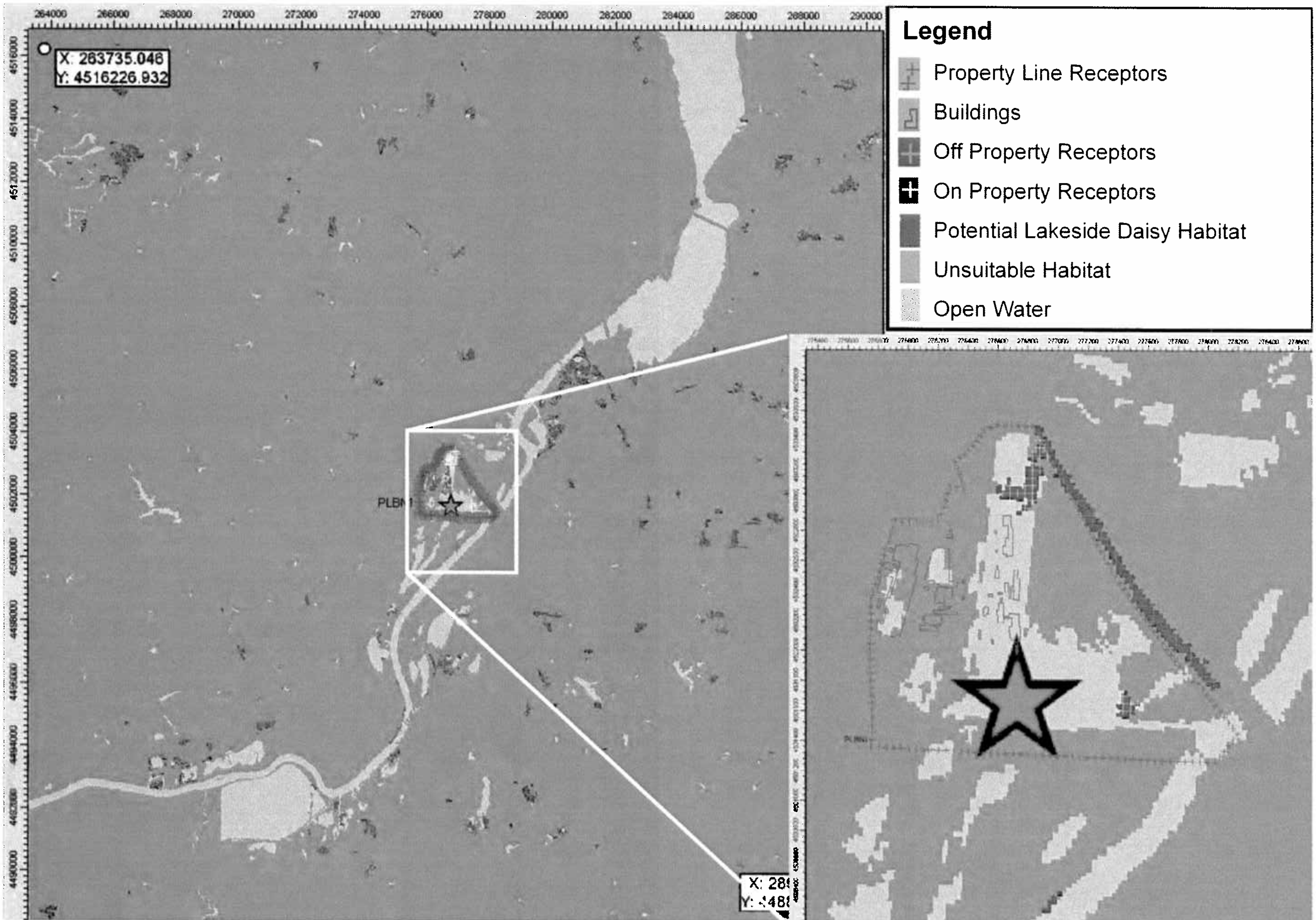


Figure 10 – Potential Lakeside Daisy Habitat with Receptors Overlaid

Note: Some areas of the site shown as open water are, upon review of current aerial photographs, buildings, roadways, and parking areas

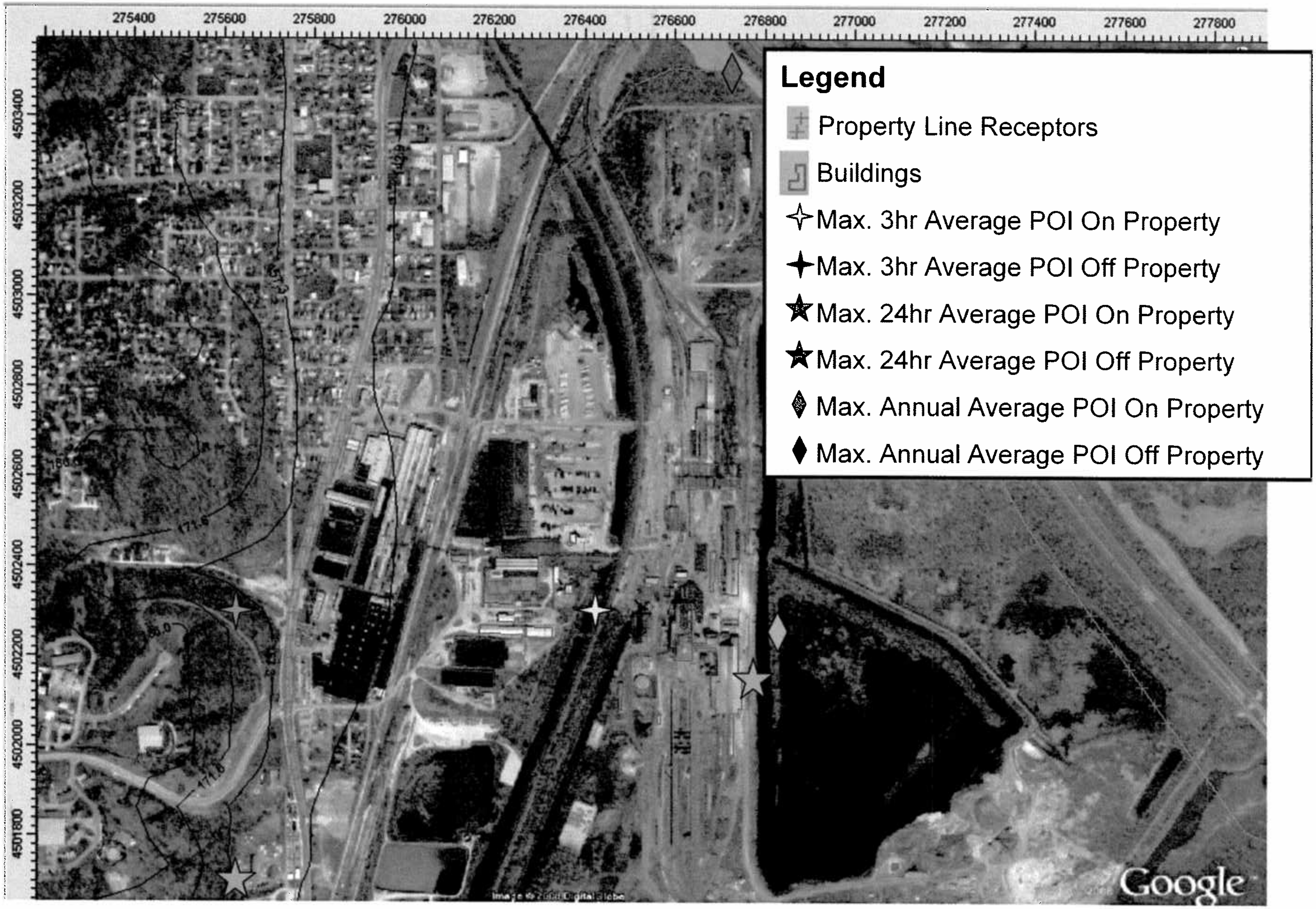


Figure 11 – Maximum Point of Impingement Concentrations On and Off Property for 3 hr, 24 hr and Annual Averaging Periods

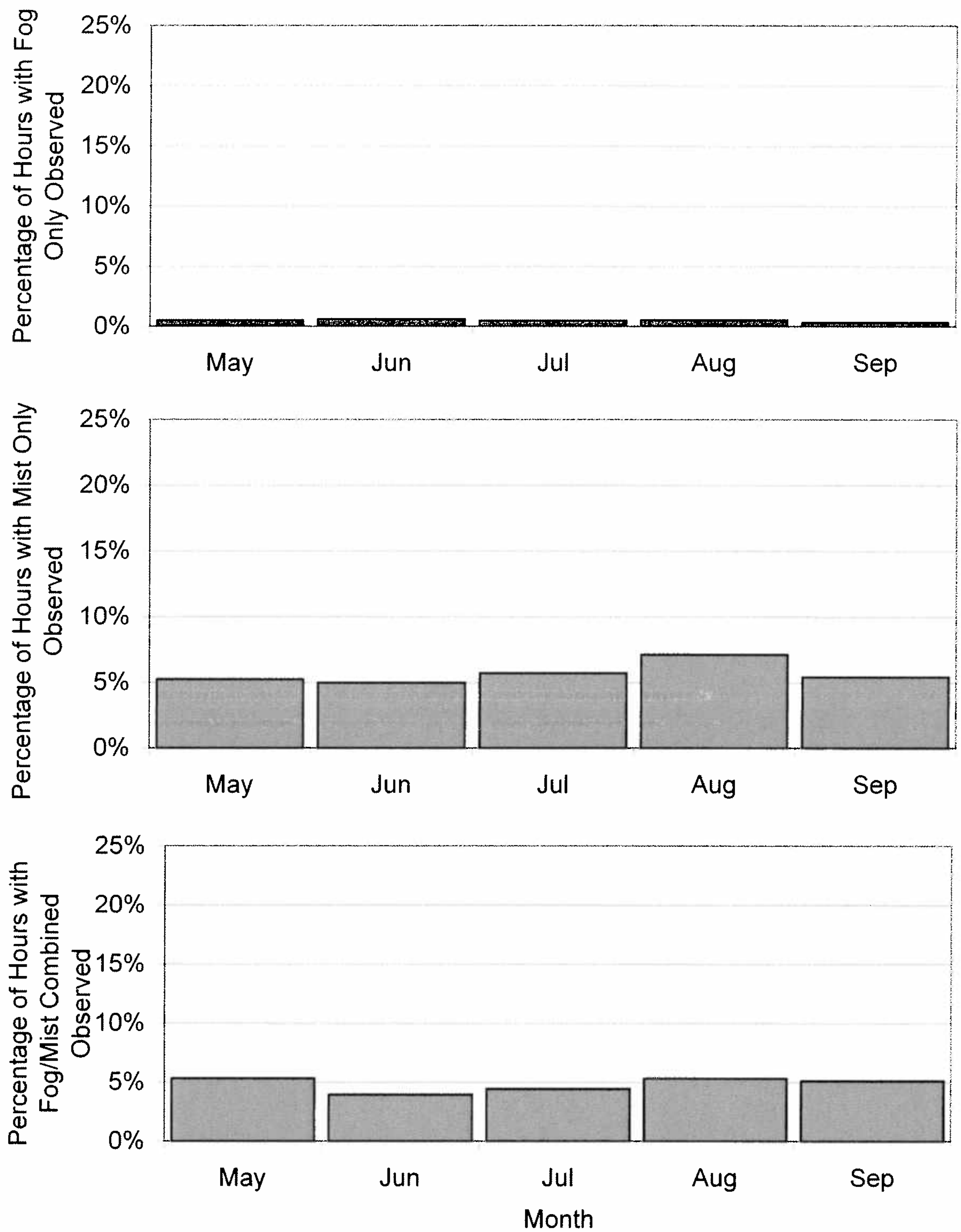


Figure 12 - Percentage of Total Hourly Observations of Fog, Mist, and Fog/Mist Combined, by Time of Year During the Growing Season (May - Sept) from 2003 - 2007 at Peoria Airport Weather Station (WBAN ID 14842)

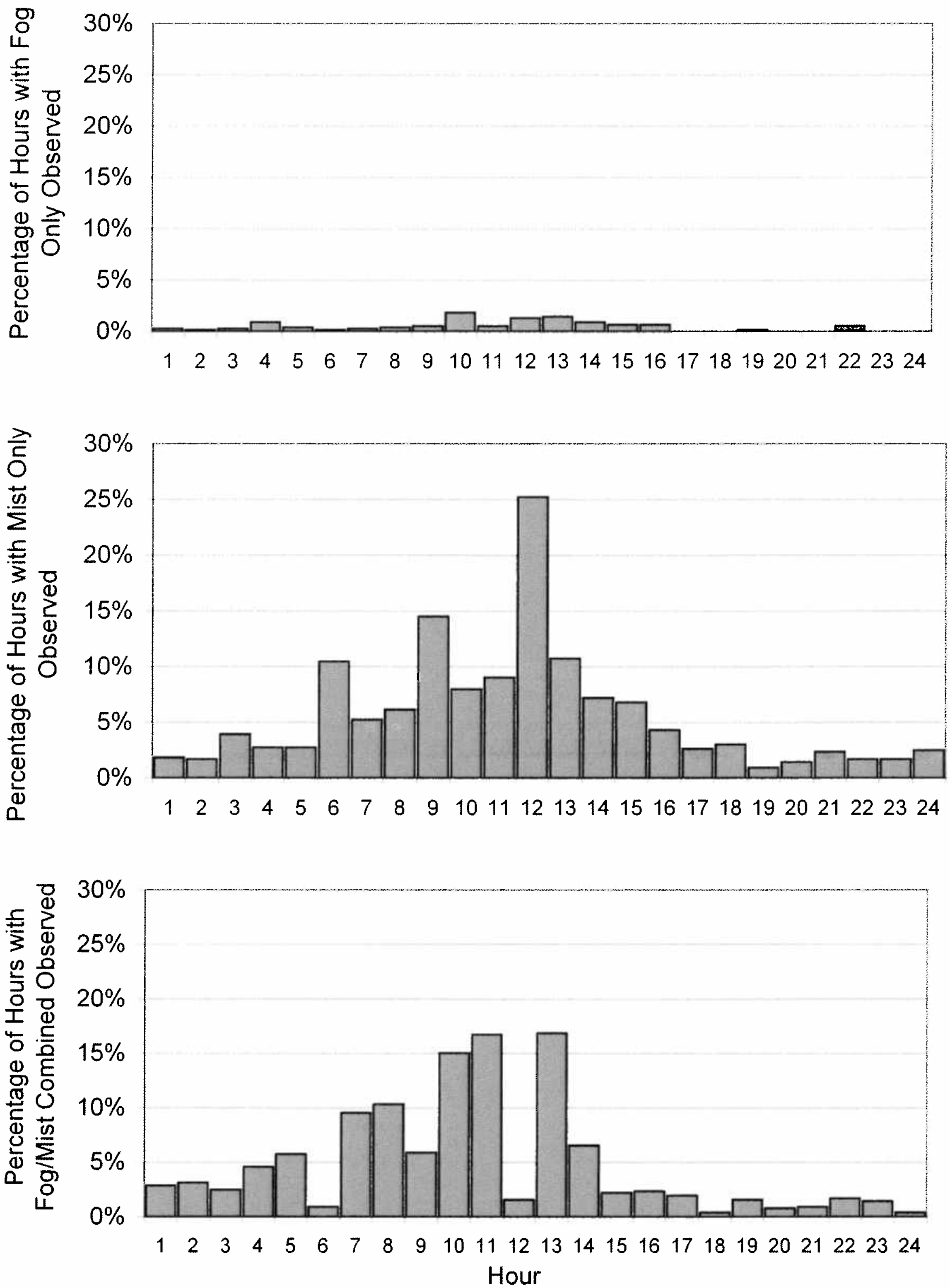


Figure 13 - Percentage of Total Hourly Observations of Fog, Mist, and Fog/Mist Combined, by Time of Day During the Growing Season (May - Sept) from 2003 - 2007 at Peoria Airport Weather Station (WBAN ID 14842)

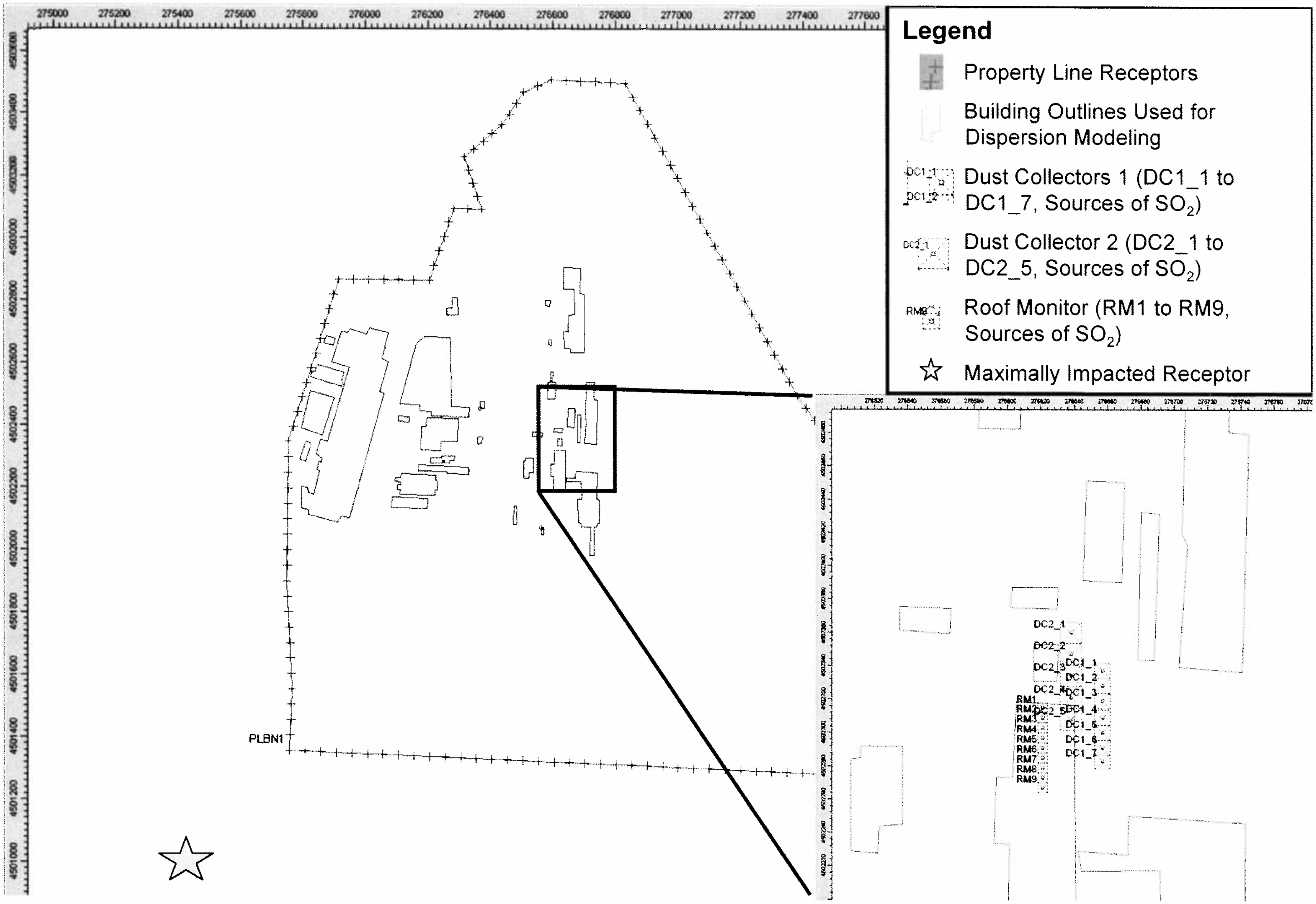


Figure 14 – Maximally Impacted Ecological Receptor for Acid Fog Analysis and Keystone Volume Sources of SO_2

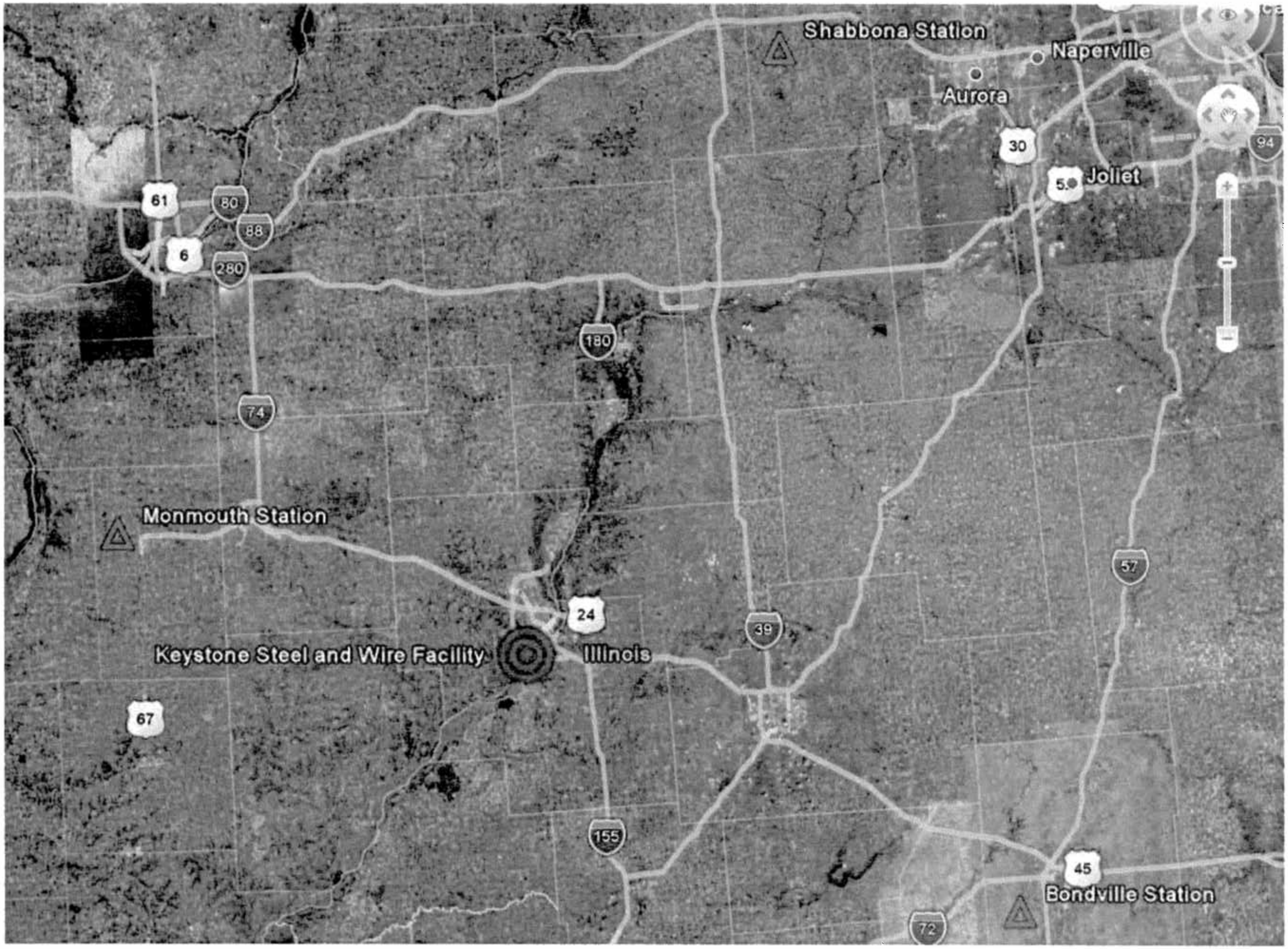


Figure 15 – Nearest Operating National Atmospheric Deposition Program (NADP) Monitoring Stations to the Keystone Steel and Wire Facility

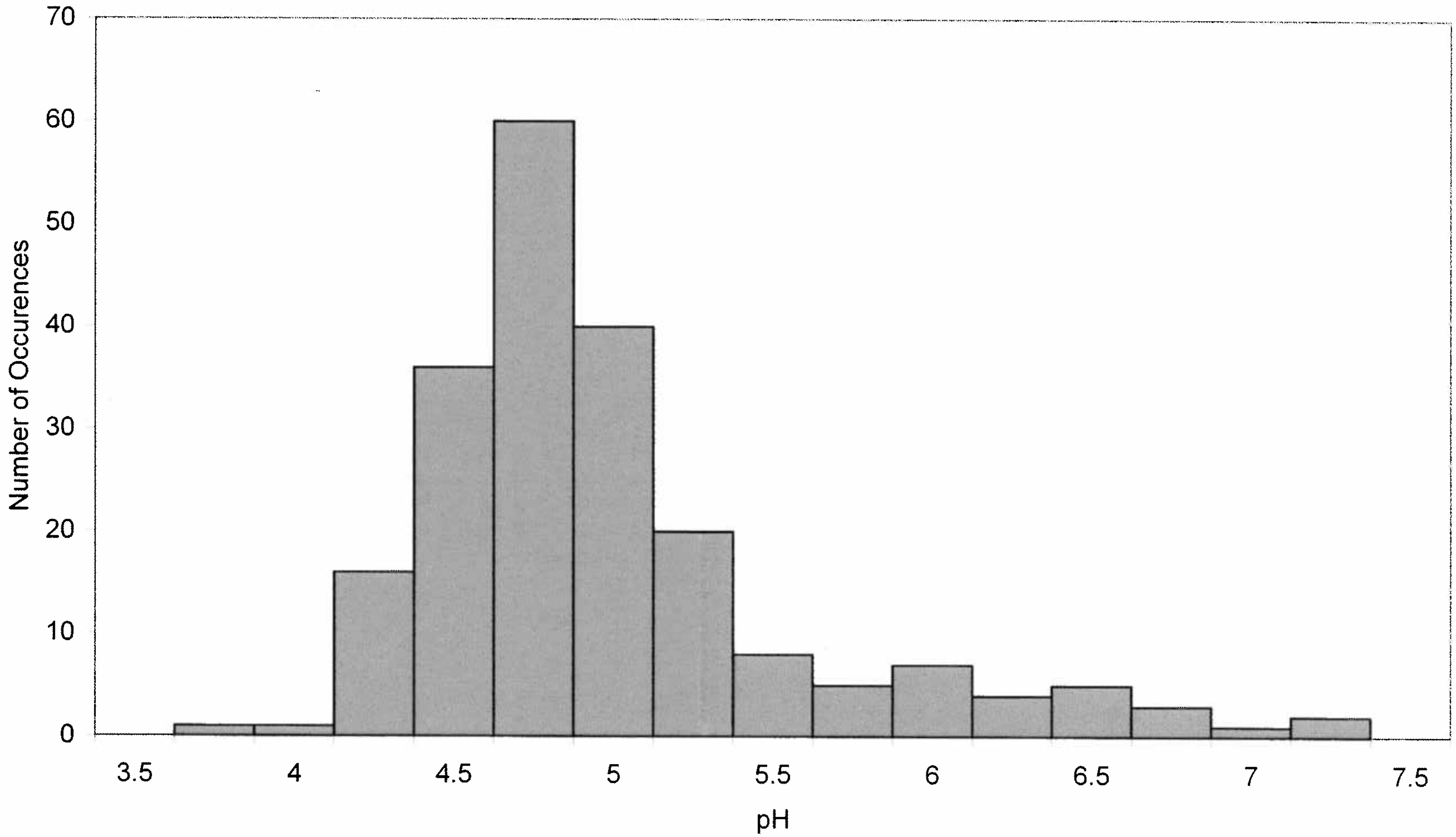


Figure 16 - Distribution of Weekly Lab Measured pH from 2003 - 2007 at the Bondville National Atmospheric Deposition Program (NADP) Monitoring Station (IL11)

Note: The minimum weekly laboratory pH value was 3.56 and the mean weekly laboratory pH value was 4.85. The minimum weekly laboratory pH value was used as a conservative estimate of the background pH for analysis

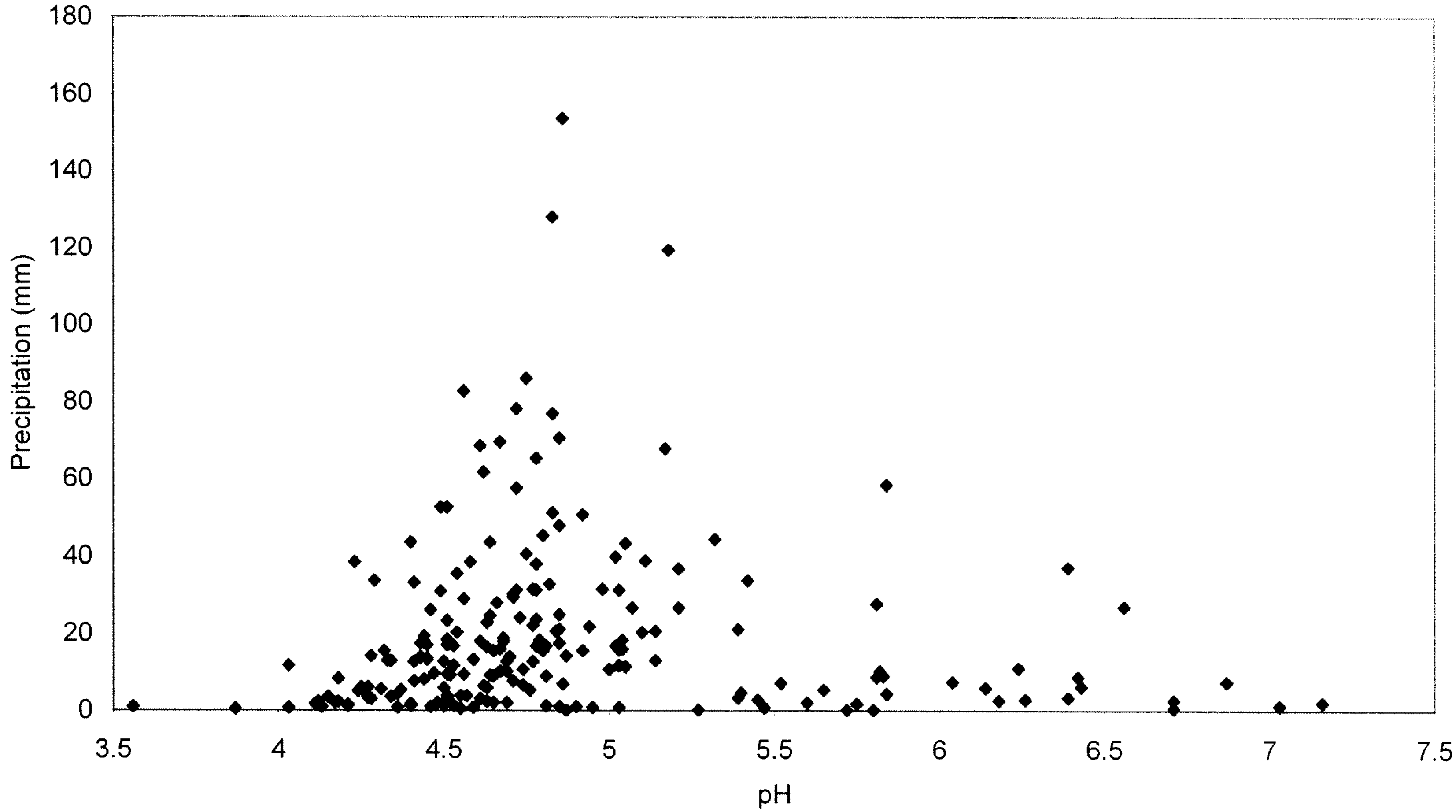


Figure 17 - Scatterplot of Precipitation vs. Weekly Lab Measured pH from 2003 - 2007 at the Bondville National Atmospheric Deposition Program (NADP) Monitoring Station (IL11)

Note: Extreme high and low pH measurements occur during periods of low precipitation, such as would occur during fog, mist, or very light rain, however not all low precipitation measurements have extreme pH.

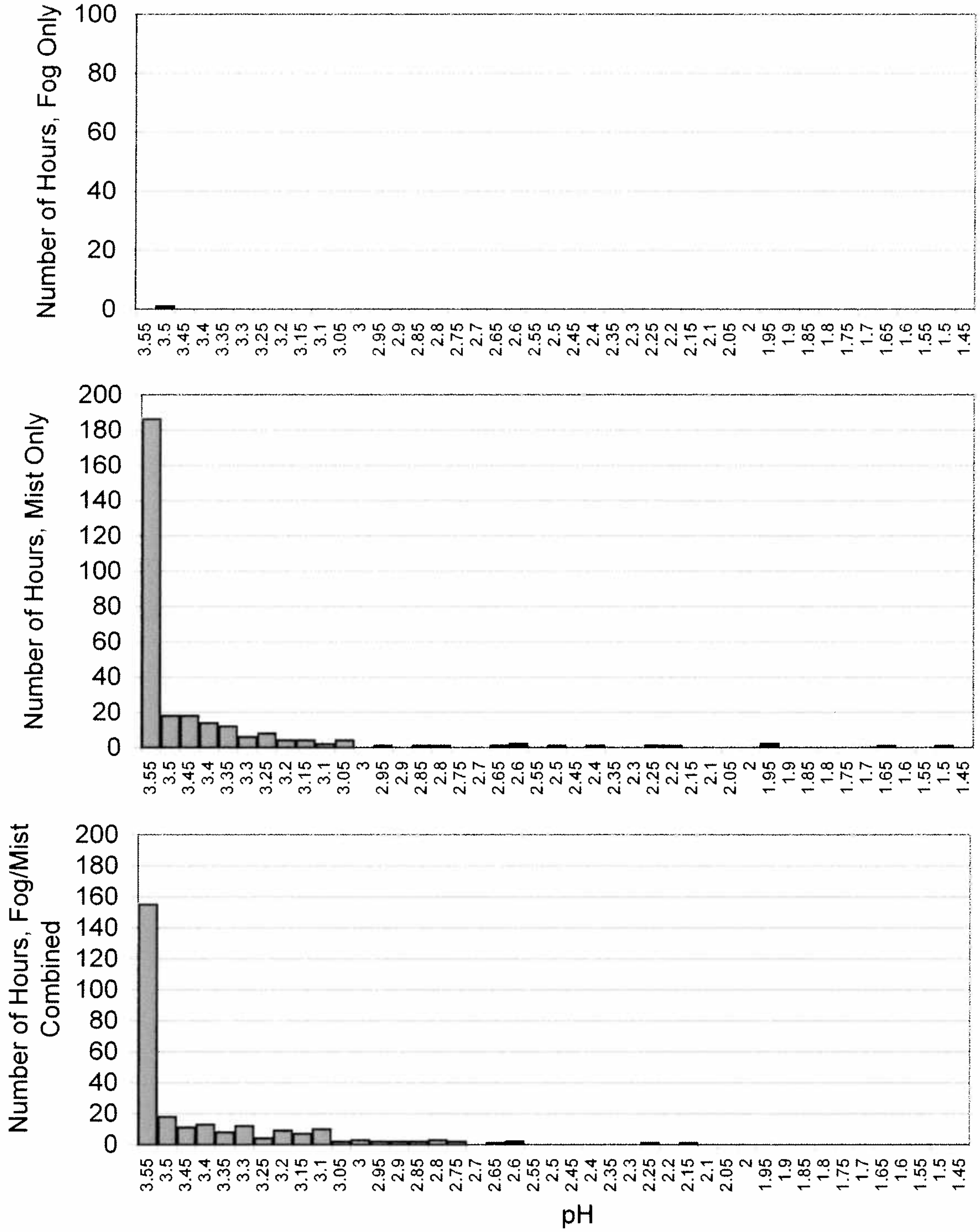


Figure 18 - Predicted 1 hr Average pH of Fog Only, Mist Only, and Combined Fog/Mist events During the Growing Season (May - Sept) from 2003 - 2007 at the Maximally Impacted Ecological Receptor UTM(275430, 4501000)

Note: Events where the pH decreased by less than 0.01 units are not shown on the histograms above to control the vertical scale. There were 85, 756, and 619 hours where the pH did not decrease by 0.01 units during an occurance fog only, mist only, and fog/mist combined, respectively.

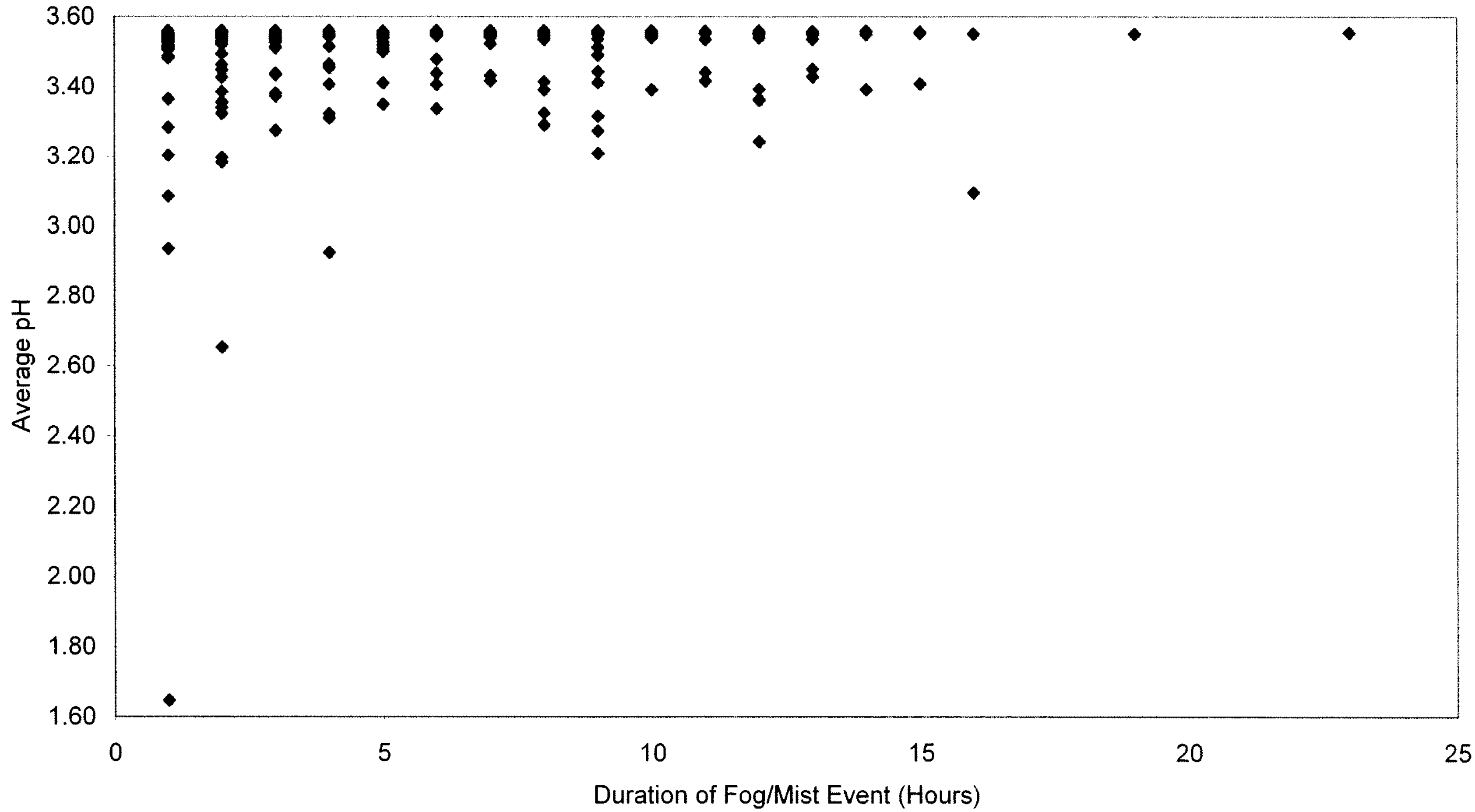


Figure 19 - Scatterplot of Event-Averaged pH and Fog/Mist Event Duration for All Events During the Growing Season from 2003 - 2007 at the Maximally Impacted Receptor UTM(275430,4501000)

Note: Starting pH = 3.56 for all events, with an SO_2 half-life in air of 4 hours

Appendix

Protocol used for Air Quality Modeling
prepared in support of an
Endangered Species Evaluation

Introduction

Project Overview

Keystone Steel & Wire Company (Keystone) is preparing to submit a Prevention of Significant Deterioration (PSD) application for an increase in SO_2 emissions from the electric arc furnace (EAF) and ladle metallurgical furnace (LMF) at their Peoria, Illinois facility (see Figure A.1).

Keystone plans to request an SO_2 Best Available Control Technology (BACT) limit of 0.60 pound SO_2 per ton steel (lb SO_2/ton steel) within their PSD application. This emission limit, coupled with a short term maximum production rate of 160 tons of steel per hour (ton/hr) and an annual production limit of 820,000 tons of steel per year (ton/yr), will form the basis for maximum hourly and annual SO_2 emission rates.

The State of Illinois administers and enforces the federal PSD program under a delegation agreement with the United States Environmental Protection Agency (USEPA). The State of Illinois also has the authority to enforce its own PSD program, as set out in the state regulations. U.S. EPA (USEPA) Region 5 requires an evaluation of potential impacts of the proposed Keystone production capacity expansion on threatened or endangered species populations or their critical habitats as part of the PSD air permitting process administered through the Illinois Environmental Protection Agency (IEPA).

Modeling Approach

This modeling report presents the approach and results used to conduct the AERMOD modeling predictions for the acid fog analysis which is the basis of the endangered species evaluation. Specifically, the AERMOD modeling results were used to predict the potential net increase in atmospheric concentrations of SO_2 as a result of the facility operating at the new PSD limit. The methodology used to conduct the acid fog analysis is provided in the Endangered Species Evaluation.

The AERMOD modeling consisted of three parts: (1) determination of the maximum point of impingement concentration of SO_2 for 3-hr, 24-hr, and annual averaging periods which were used to evaluate whether the resultant emissions would be within the allowable benchmarks for species in the area; (2) determination of the location of the maximally impacted ecological receptor; and (3) determination of hourly concentrations at the maximally impacted ecological receptor (from (2)) for use with surface weather data to evaluate the impacts of acid fog events on the baseline pH for the area.

Emission Sources

The emission sources included in the analysis are the Keystone EAF, LMF, ladle pre-heaters and sequence caster. The EAF and LMF emissions are directed to two baghouses. The ladle pre-heater and sequence caster emissions are directed to a roof monitor. SO_2 has 3-hr, 24-hr and annual ecological benchmark concentrations for comparison with the predicted point of impingement concentrations. Since Keystone operates 24 hours per day (hr/day), the short-term emission rates (3-hr and 24-hr) were determined from the maximum hourly SO_2 emissions. For the long-term emission rates (annual), the annual maximum resultant emissions were calculated from a proposed limit of 0.60 lb SO_2/ton steel and an annual production limit of 820,000 tons/yr. Since Keystone operates 365 day/yr, these emissions were divided by 8,760 hr/yr to produce an equivalent hourly emission rate.

The emission rate modeled was determined based on a net difference between the most recent compliance stack testing data showing a current operating emission rate of 0.42 lb/ton, and the proposed limit 0.60 lb SO_2/ton steel. Using the difference between the current emission rate for SO_2 and the proposed limit was identified as being the most representative "resultant emissions" scenario because the basis for the Endangered Species Evaluation is to provide predictions for the impact on air quality (as compared against the ecological benchmark value in the context of existing air quality) and pH (as compared to the baseline pH for the area).

Dispersion Modeling

The expected ambient air concentration of SO_2 in the vicinity of the facility was estimated using dispersion modeling techniques. According to *Revision to the Guideline on Air Quality Models*[1], the American Meteorological Society/USEPA Regulatory Model (AERMOD) is the preferred model for this type of application. AERMOD is a near-field, steady-state Gaussian plume model, and uses site-representative hourly surface and twice-daily upper air meteorological data to simulate the effects of dispersion of emissions from industrial-type releases (e.g., point, area, and volume) for distances of up to 50 kilometers (km).[2]

AERMOD is appropriate for use in estimating ground-level short-term ambient air concentrations resulting from non-reactive buoyant emissions from sources located in simple and complex terrain. This majority of analysis will be conducted using AERMOD (version 07026) in the regulatory default mode, which includes the following modeling control options:

1 United States Environmental Protection Agency (USEPA). 2005. Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule. 40 CFR Part 51, Appendix W (Federal Register) 70216.

2 Ibid.

- adjusting stack heights for stack-tip downwash (except for building downwash cases),
- incorporating the effects of elevated terrain,
- employing the calms processing routine, and
- employing the missing data processing routine.

Deviation from regulatory defaults was introduced in order to estimate the mass of SO_2 that would enter the aqueous phase during fog/mist events using the exponential decay option with the USEPA recommended half-life of 4 hours.

Modeled Sources

For use in AERMOD, ENVIRON determined the Keystone emission source parameters (e.g., location, height, temperature, stack diameter, stack exit velocity, etc.) based on information from the facility design, including relevant stack tests and plot plans. The modeling parameters and net emission rate increases of the Keystone sources to be included in the modeling are summarized in Table A.1. Figure A.2 identifies the locations of the sources to be included in the modeling. Figure A.3 shows the location of the buildings on site that were included in the modeling.

One third of the SO_2 emissions from the EAF and LMF are directed to baghouse DC1 with 7 cells (DC1_1 through DC1_7) and the remaining two-thirds are directed to baghouse DC2 with 5 cells (DC2_1 through DC2_5). Each of the baghouses was modeled as a volume source. The ladle pre-heaters and sequence caster emissions were divided between nine sections (RM1 through RM9) of the roof monitor and modeled as volume sources.

Table A.1 Keystone Modeling Sources and Parameters for the Endangered Species Evaluation

Source Description	Source ID	UTM Coordinates Easting (m)	UTM Coordinates Northing (m)	Base Elev. (m)	Release Height Above (m)	Init. Horiz-ontal Dimen-sion (m)	Init. Vertical Dimen-sion (m)	SO_2 Emissions Increase Max. 3-hr, 24-hr (g/s)	SO_2 Emissions Increase Max. Annual (g/s)
Baghouse 1, Cell 1	DC1_1	276657	4502337	137.16	21.95	2.13	9.64	0.3527	0.1139
Baghouse 1, Cell 2	DC1_2	276657	4502328	137.16	21.95	2.13	9.64	0.3527	0.1139
Baghouse 1, Cell 3	DC1_3	276657	4502319	137.16	21.95	2.13	9.64	0.3527	0.1139
Baghouse 1, Cell 4	DC1_4	276657	4502309	137.16	21.95	2.13	9.64	0.3527	0.1139
Baghouse 1, Cell 5	DC1_5	276657	4502300	137.16	21.95	2.13	9.64	0.3527	0.1139
Baghouse 1, Cell 6	DC1_6	276657	4502291	137.16	21.95	2.13	9.64	0.3527	0.1139
Baghouse 1, Cell 7	DC1_7	276657	4502283	137.16	21.95	2.13	9.64	0.3527	0.1139
Baghouse 2, Cells 1	DC2_1	276638	4502360	137.16	23.48	3.03	8.93	0.9889	0.3193
Baghouse 2, Cells 2	DC2_2	276638	4502347	137.16	23.48	3.03	8.93	0.9889	0.3193
Baghouse 2, Cells 3	DC2_3	276638	4502334	137.16	23.48	3.03	8.93	0.9889	0.3193
Baghouse 2, Cells 4	DC2_4	276638	4502321	137.16	23.48	3.03	8.93	0.9889	0.3193
Baghouse 2, Cells 5	DC2_5	276638	4502308	137.16	23.48	3.03	8.93	0.9889	0.3193
Roof Monitor Section 1	RM1	276621	4502315	137.16	55.49	1.38	25.52	0.0003	0.0003
Roof Monitor Section 2	RM2	276621	4502309	137.16	55.49	1.38	25.52	0.0003	0.0003
Roof Monitor Section 3	RM3	276621	4502303	137.16	55.49	1.38	25.52	0.0003	0.0003
Roof Monitor Section 4	RM4	276621	4502297	137.16	55.49	1.38	25.52	0.0003	0.0003
Roof Monitor Section 5	RM5	276621	4502291	137.16	55.49	1.38	25.52	0.0003	0.0003
Roof Monitor Section 6	RM6	276621	4502285	137.16	55.49	1.38	25.52	0.0003	0.0003
Roof Monitor Section 7	RM7	276621	4502279	137.16	55.49	1.38	25.52	0.0003	0.0003
Roof Monitor Section 8	RM8	276621	4502273	137.16	55.49	1.38	25.52	0.0003	0.0003
Roof Monitor Section 9	RM9	276621	4502267	137.16	55.49	1.38	25.52	0.0003	0.0003

Terrain

Terrain elevations were incorporated into the modeling using version 06341 of AERMAP, AERMOD's terrain preprocessor. Terrain elevation data for the entire modeling domain will be extracted from 7.5-minute Digital Elevation Model files with a 30-meter (m) grid spacing produced by the United States Geological Survey (USGS).

Land Use Classification

Auer's method of classifying land-use as either rural or urban was used to analyze the region in which the facility is located. This method calls for analysis of the land within a 3-km radius from the facility to determine if the majority of the land can be classified as either rural (i.e. undeveloped) or urban. If more than fifty percent of the area circumscribed by this 3-km radius circle consists of Auer land-use industrial, commercial or residential land types, then urban dispersion coefficients are used in modeling; otherwise, rural dispersion coefficients are used. The aerial photo of the area, Figure A.4, shows that a large portion of the land within 3 km of the facility remains undeveloped and exhibits characteristics of rural terrain. Therefore rural dispersion coefficients were used.

Meteorological Data

Data Selection

AERMOD requires a meteorological input file to characterize the transport and dispersion of pollutants in the atmosphere. Surface and upper air meteorological data inputs as well as surface parameter data describing the land use and surface characteristics near the site are first processed using AERMET, the meteorological preprocessor to AERMOD. The output file generated by AERMET is the meteorological input file required by AERMOD.

For air dispersion modeling purposes, USEPA recommends using a minimum of one year of on-site meteorological data or five years of nearby meteorological data. For this dispersion modeling, nearby meteorological data from the most recent five years available (2003-2007) were used in AERMET processing.

The hourly surface data was obtained from the National Weather Service (NWS) station at the Greater Peoria Regional Airport (NWS Station 72532). The surface station is approximately 4 km to north-northwest of the Keystone facility with similar terrain characteristics (see Figure A.5). The upper air meteorological data was obtained from the NWS station at the Logan County Airport (NWS Station 4833) which is approximately 60 km to the south-southeast (see Figure A.5) of the Keystone facility.

USEPA has established criteria for the use of meteorological data for modeling purposes in *Meteorological Monitoring Guidance for Regulatory Modeling Applications.* This guidance states that meteorological data should be 90% complete on a quarterly basis before any substitutions are made. The 90% completeness requirement was assessed for each required meteorological variable separately as well for the joint recovery of surface wind speed, wind direction, ambient temperature, sky cover, and ceiling height. Each of the quarters was over 90% complete making the data set appropriate for use in the current modeling work. The completeness of the surface meteorological parameters for each quarter is summarized in Table A.2.

Table A.2 Keystone Met Data Completeness Check

Year	Quarter	Ceiling Height	Wind Speed	Wind Direction	Pressure	Temperature	Cloud Cover	Overall
2003	1	98.80	98.56	98.80	98.80	98.80	93.43	98.17
2003	2	100.00	99.68	100.00	100.00	100.00	96.29	99.42
2003	3	100.00	99.95	100.00	100.00	100.00	97.69	99.66
2003	4	99.37	98.28	98.28	99.37	99.37	95.38	98.58
2003	ALL	99.54	99.12	99.27	99.54	99.54	95.71	98.96
2004	1	98.99	98.95	98.99	98.99	98.81	95.65	98.59
2004	2	100.00	99.91	100.00	100.00	99.95	97.57	99.63
2004	3	99.46	99.37	99.46	99.46	99.41	97.15	99.13
2004	4	100.00	98.91	98.91	100.00	100.00	97.69	99.36
2004	ALL	99.61	99.28	99.34	99.61	99.54	97.01	99.18
2005	1	98.33	95.05	98.33	98.33	98.33	98.33	97.86
2005	2	99.18	95.65	99.18	99.18	99.18	99.18	98.67
2005	3	98.32	90.31	98.32	98.32	98.32	98.32	97.18
2005	4	96.11	92.48	94.93	96.11	96.11	96.06	95.41
2005	ALL	97.98	93.36	97.68	97.98	97.98	97.97	97.27
2006	1	97.92	95.05	97.82	97.92	97.92	97.92	97.49
2006	2	99.68	94.32	99.68	99.68	99.68	99.68	98.91
2006	3	99.77	94.20	99.64	99.77	99.77	99.77	98.96
2006	4	98.05	95.11	96.11	98.05	98.05	98.05	97.35
2006	ALL	98.86	94.67	98.31	98.86	98.86	98.86	98.18
2007	1	98.61	96.39	97.78	98.61	98.52	98.61	98.09
2007	2	98.17	94.92	98.12	98.17	98.12	98.17	97.61
2007	3	97.42	92.75	97.06	97.42	97.42	97.37	96.57
2007	4	98.87	96.15	97.69	98.87	98.87	98.82	98.21
2007	ALL	98.26	95.05	97.66	98.26	98.23	98.24	97.62

Surface Characteristics

Prior to running AERMET, it is necessary to specify the surface characteristics around the application site. The IEPA has developed surface characteristics for the State of Illinois and provides this data for modeling purposes within the state. The surface characteristics for Stage 3 AERMET processing were provided by the IEPA for the modeling period 2003-2007[3].

AERMOD Meteorological Data File Generation

For each year, surface and upper air data files were combined using version 06341 of AERMET to develop the required model-ready meteorological data files. AERMET processes the data in three stages. The first stage extracts meteorological data from archive data files and processes the data through various quality assessment checks. The second stage merges all data available for 24-hr periods and stores these data together in a single file. The third stage reads the merged meteorological data and estimates the necessary boundary layer parameters for use by AERMOD. Following USEPA's guidance, the upper air data was subject to preliminary quality control by employing the MODIFY keyword, which makes three adjustments to the sounding data: first, it deletes mandatory levels from the sounding; second, it sets non-zero wind directions to zero if the wind speed is zero; third, it replaces missing ambient and dew point temperatures with interpolated values. For each year, AERMET generates two files for AERMOD: a file of hourly boundary layer parameter estimates and a file of multiple-level observations of wind speed and direction, temperature, and the standard deviation of the fluctuating components of wind.

Meteorological Data Trends

The five years of model-ready surface and profile meteorological data files were used to create wind roses in Lakes Environmental's WRPlot View (see Figures A.6 through A.10).

<u>Receptors</u>

The location of ecological receptors was determined using GIS maps of the area surrounding Keystone. Grids were overlaid on maps of the potential habitat for four species of concern. Universal Transverse Mercator (UTM) coordinates of intersection points of the grid within potential habitat were used as receptors in AERMOD. Grid spacing was chosen to capture a representative sample of habitat while maintaining an appropriate total number of receptors.

For the Decurrent False Aster, Lakeside Daisy, and Eastern Prairie Fringed Orchid a 4000 m by 4000 m grid with 50 m spacing was laid over the center of the facility. Outside the 4000 m grid, a 27,000 m X 27,000 m grid with 100 m spacing was overlaid on the habitat maps.

For the Indiana Bat a 4000 m by 4000 m grid with 100 m spacing was laid over the center of the facility. Outside the 4000 m grid, a 20,000 m X 20,000 m grid with 500 m spacing was overlaid on the habitat maps.

[3] Stage 3 AERMET surface characteristics were provided by Matt Wills from the IEPA in November 2008.

Background Concentration

The maximum 3-hr, 24-hr and annual concentrations of SO_2 were acquired from the monitor located at the Peoria Fire Station #8 (monitor number 1430024) at the corner of MacArthur and Hurlburt as a background concentration representative of local activities. This background monitor is the closest to the Keystone facility and was previously approved by the IEPA for PSD application submitted by Keystone in 1999. The background levels measured at the monitor are presented with the modeling results to provide context for the air quality predictions as compared to the ecological benchmark concentrations. These results are presented in the Endangered Species Evaluation Report.

Air Quality Impact Analyses

The AERMOD modeling consisted of three parts: (1) Short and Long Term Impact Analysis: determination of the maximum point of impingement concentration of SO_2 for 3-hr, 24-hr, and annual averaging periods which were used to evaluate whether the resultant emissions would be within the allowable benchmarks for species in the area; (2) determination of the location of the maximally impacted ecological receptor; and (3) determination of hourly concentrations at the maximally impacted ecological receptor (from (2)) for use with surface weather data to evaluate the impacts of acid fog events on the baseline pH for the area. The following subsections describe the methodologies used to conduct this modeling.

Short-Term Impact Analysis

AERMOD dispersion modeling was used to predict the maximum 3-hr and 24-hr point of impingement concentrations at each of the ecological receptors of the 5 year period from 2003 – 2007. As per US EPA modeling guidance the second highest value was assumed to represent the worst-case SO_2 concentration for each ecological receptor identified in the modeling domain.[4]

Long-Term Impact Analysis

AERMOD dispersion modeling was used to predict the maximum annual point of impingement concentrations at each of the ecological receptors over the 5 year period from 2003 – 2007. The highest value was assumed to represent the worst-case annual concentration for each ecological receptor identified in the modeling domain.

Identification of Maximally Impacted Receptor for Acid Fog/Mist Analysis

[4] United States Environmental Protection Agency (US EPA). 1990. New Source Review Workshop Manual: Prevention of Significant Deterioration and Nonattainment Area Permitting.

The method of predicting the maximally impacted ecologic receptor depended on the mass of SO_2 that dissolved in the fog/mist. Two model runs were completed to determine the concentration of SO_2 in the aqueous phase at each receptor.

The first run predicted the highest 3-hr average concentration predictions at each receptor. A nearly identical second run was completed, with the addition of exponential decay using a 4-hr half-life for SO_2 in air. The highest 3-hr average concentration prediction at each receptor for this run represents the concentration remaining in air given some process that is removing mass form the air phase. Assuming that all mass that decayed in the second enters the aqueous phase during fog/mist events, the maximum concentration of SO_2 added to the fog/mist is the first run minus the second. The maximum difference between the two runs was considered the maximally impacted receptor discussed in the next section.

<u>Prediction of Hourly Concentrations for the Acid Fog/Mist Analysis</u>

To analyze the impact of SO_2 emission on the pH of fog/mist events, it was necessary to predict hourly concentrations of SO_2 that were scavenged by the fog/mist over the entire 5 year period. The modeling was conducted in a similar manner to the runs described in Section 3.3:

- The first run used the short term emission rates, a 1-hr averaging period, and the maximally impacted receptor only. A threshold file was created where a concentration prediction would be recorded for any 1-hr average concentration that exceeded 0 μg/m^3.

- The second run, used the exponential decay option in AERMOD with a 4-hr half-life for SO_2 in air. In this case the concentration on the threshold file resulting from the second run was subtracted from the first to predict a concentration of SO_2 that would be transferred to the moisture content in air if a fog/mist event were to coincide with the 1-hr period.

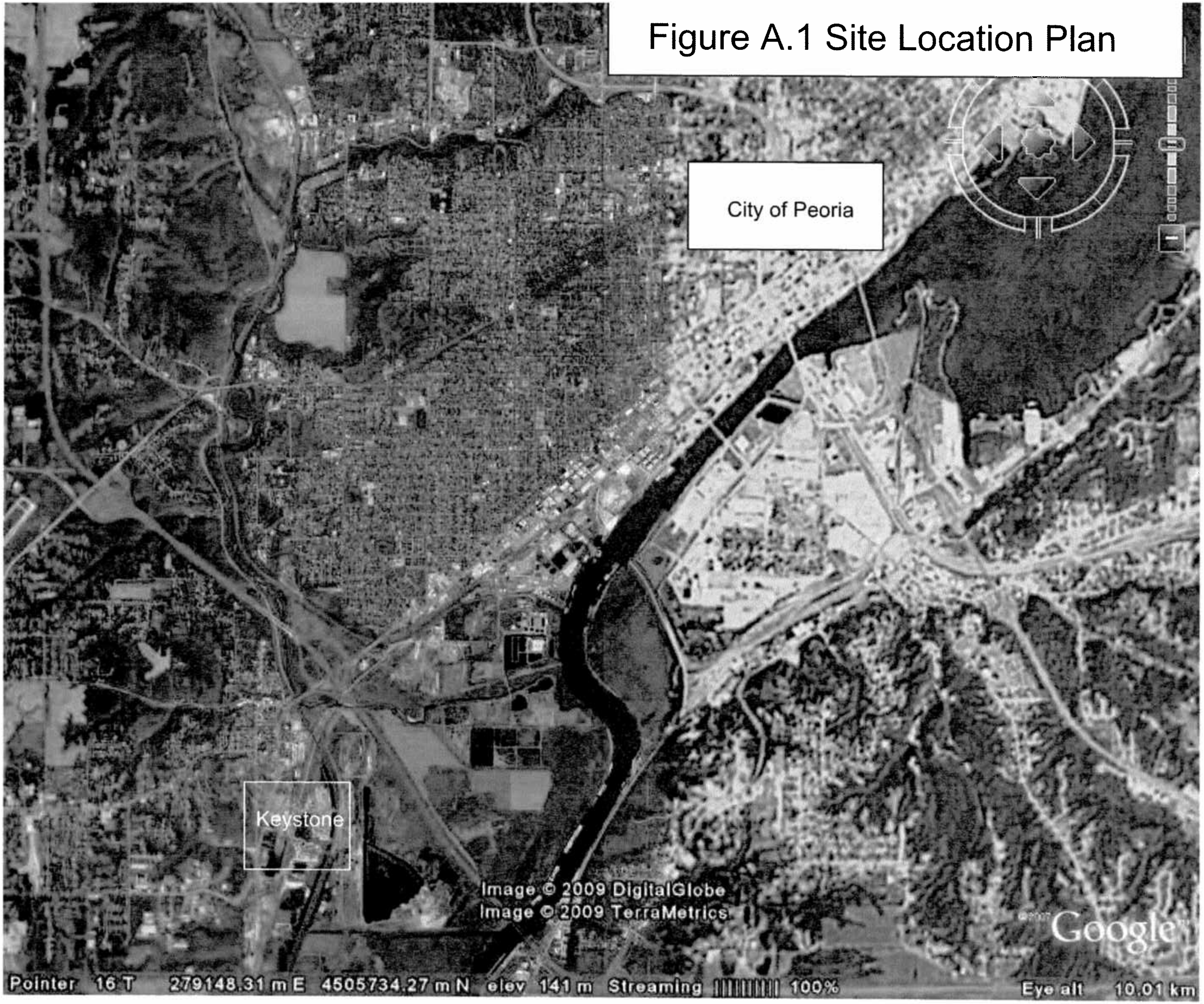
The SO2 concentration for the maximally impacted receptor then became:

$$[SO_{2(gas)}]_{Maximally\ Impacted\ Receptor}(\mu g/m^3) = \left([SO_{2(gas)}]_{Run1}(\mu g/m^3) - \left([SO_{2(gas)}]_{Run2}(\mu g/m^3)\right)\right)$$

This data was then used to estimate the impact to baseline pH from the resultant SO_2 emissions. The calculation method used to estimate the impact to baseline pH is provided in the Endangered Species Evaluation.

Appendix Figures

Figure A.1 Site Location Plan



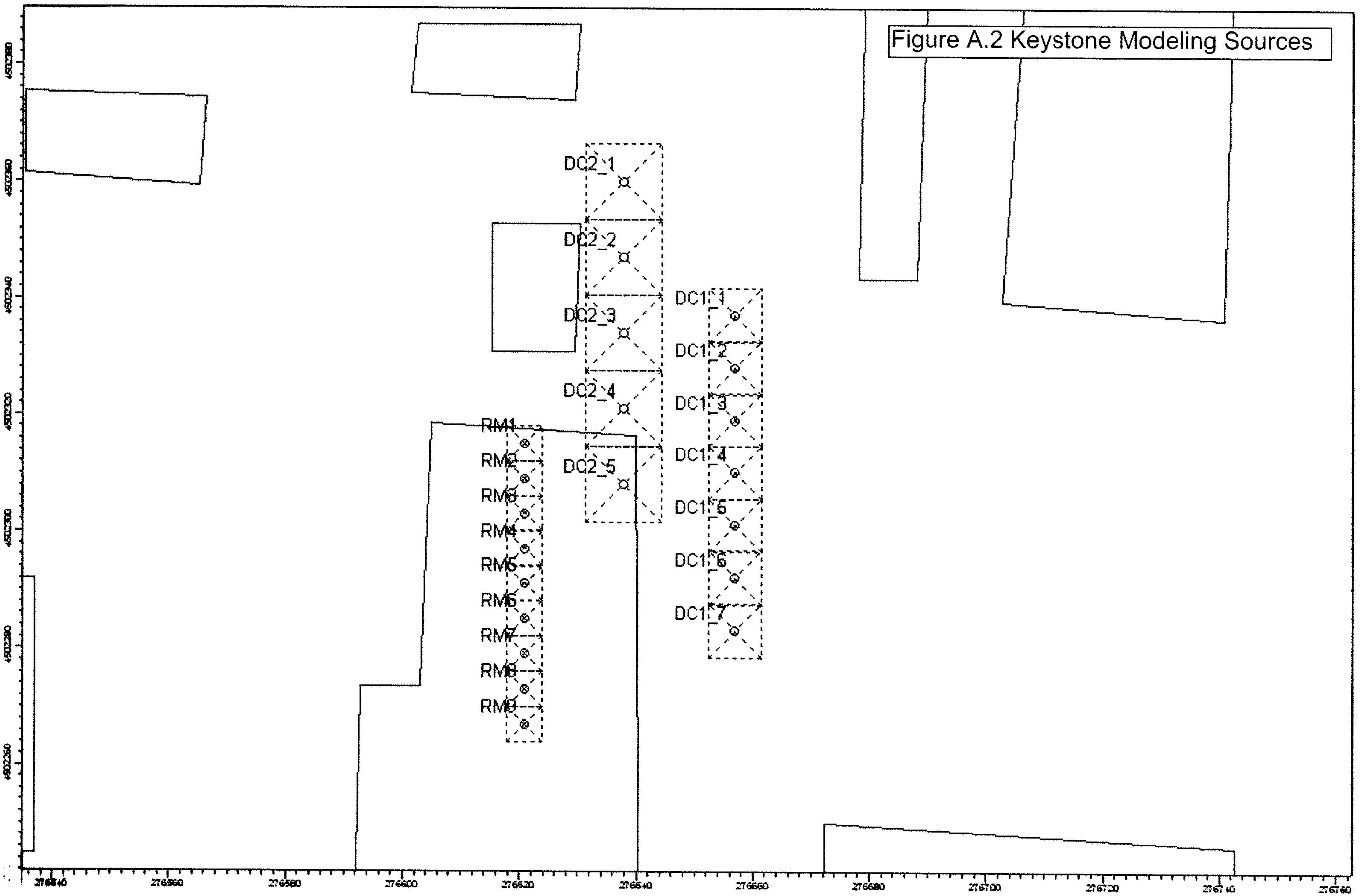
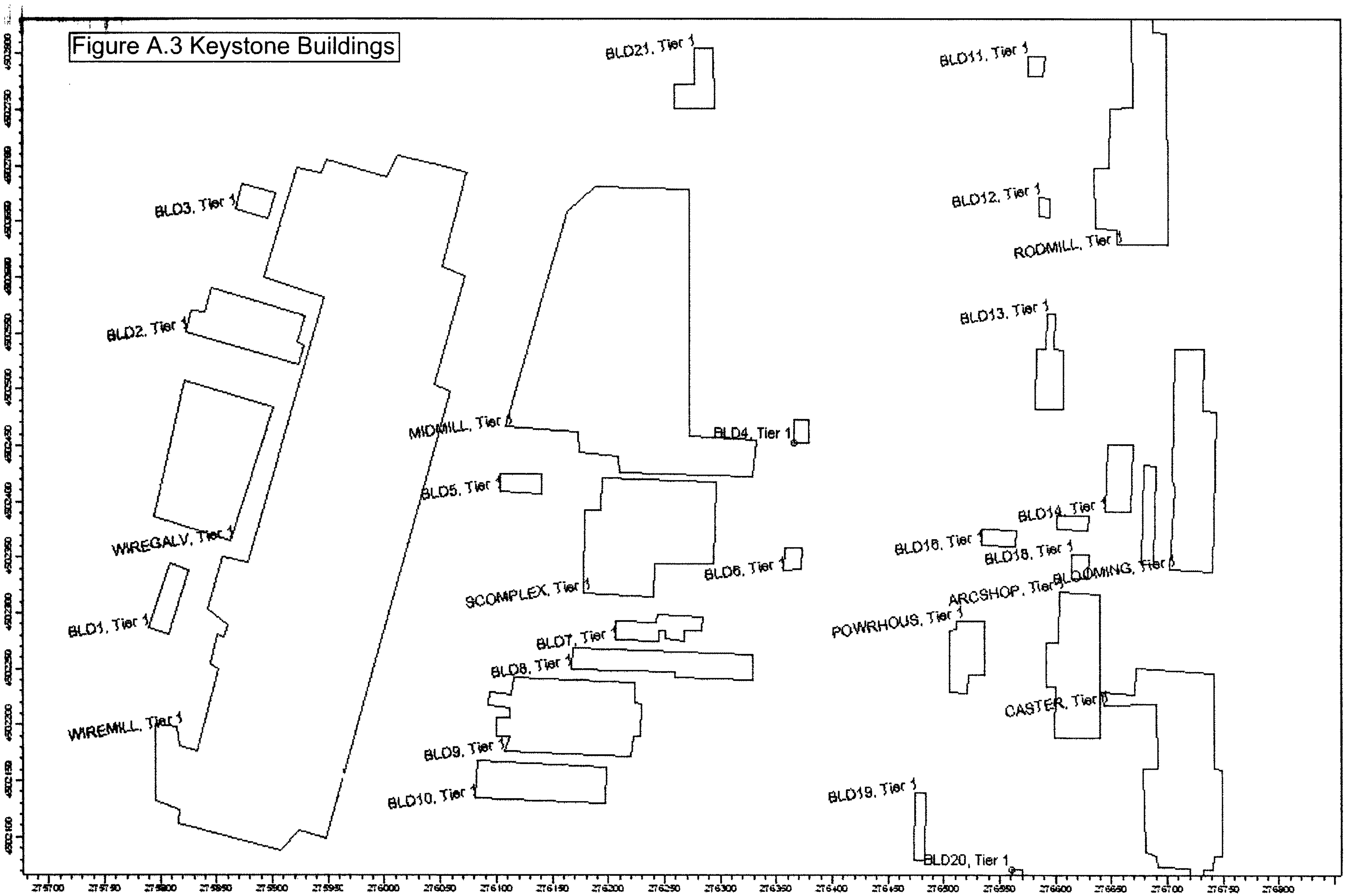


Figure A.2 Keystone Modeling Sources
DC2_1
DC2_2
DC2_3
DC2_4
DC2_5
DC1_1
DC1_2
DC1_3
DC1_4
DC1_5
DC1_6
DC1_7
RM1
RM2
RM3
RM4
RM5
RM6
RM7
RM8
RM9
4502380
4502360
4502340
4502320
4502300
4502280
4502260
276540
276560
276580
276600
276620
276640
276660
276680
276700
276720
276740
276760

Figure A.3 Keystone Buildings



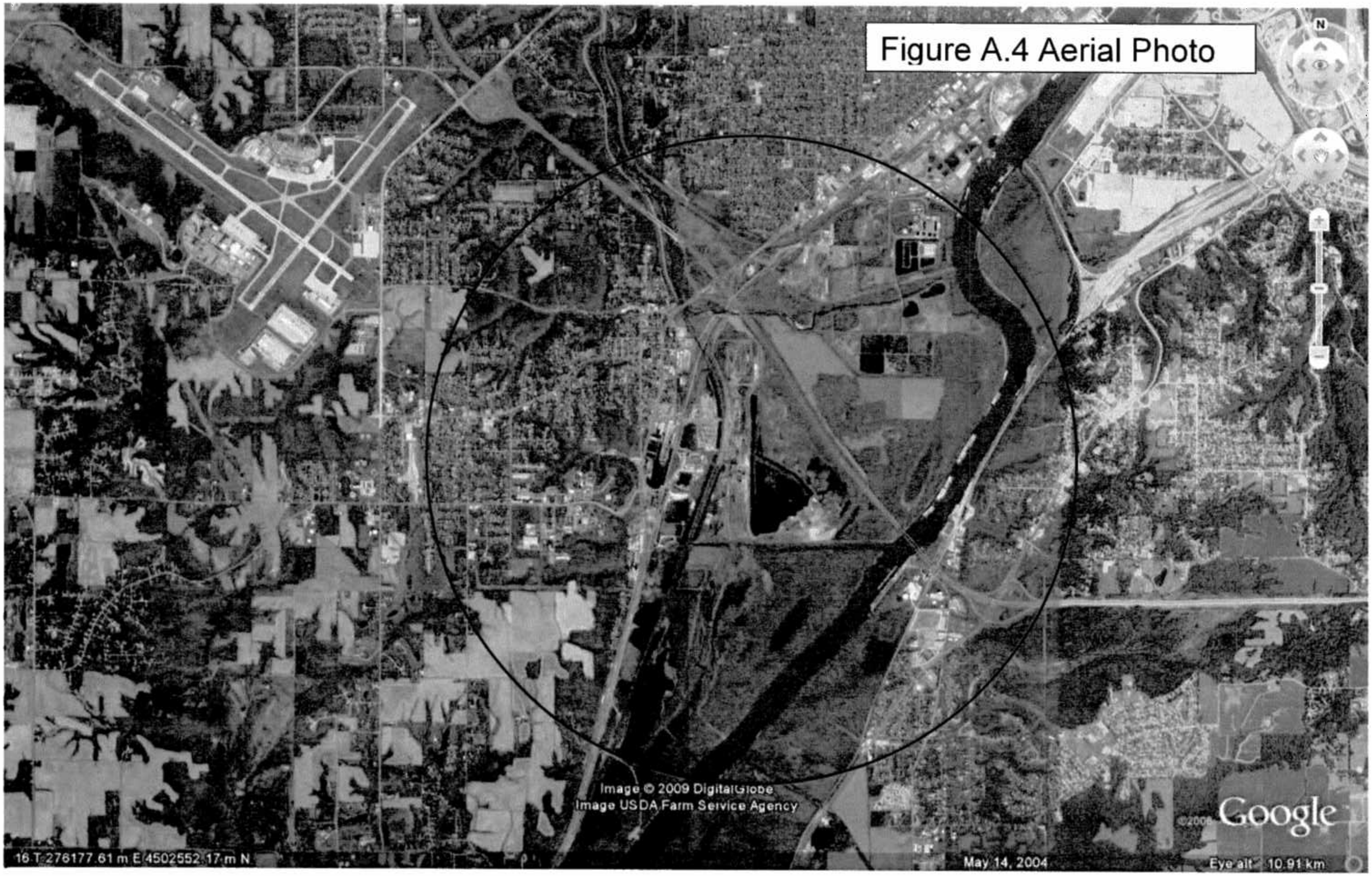


Figure A.4 Aerial Photo
N
Image © 2009 DigitalGlobe
Image USDA Farm Service Agency
Google
16 T 276177.61 m E 4502552.17 m N
May 14, 2004
Eye alt 10.91 km

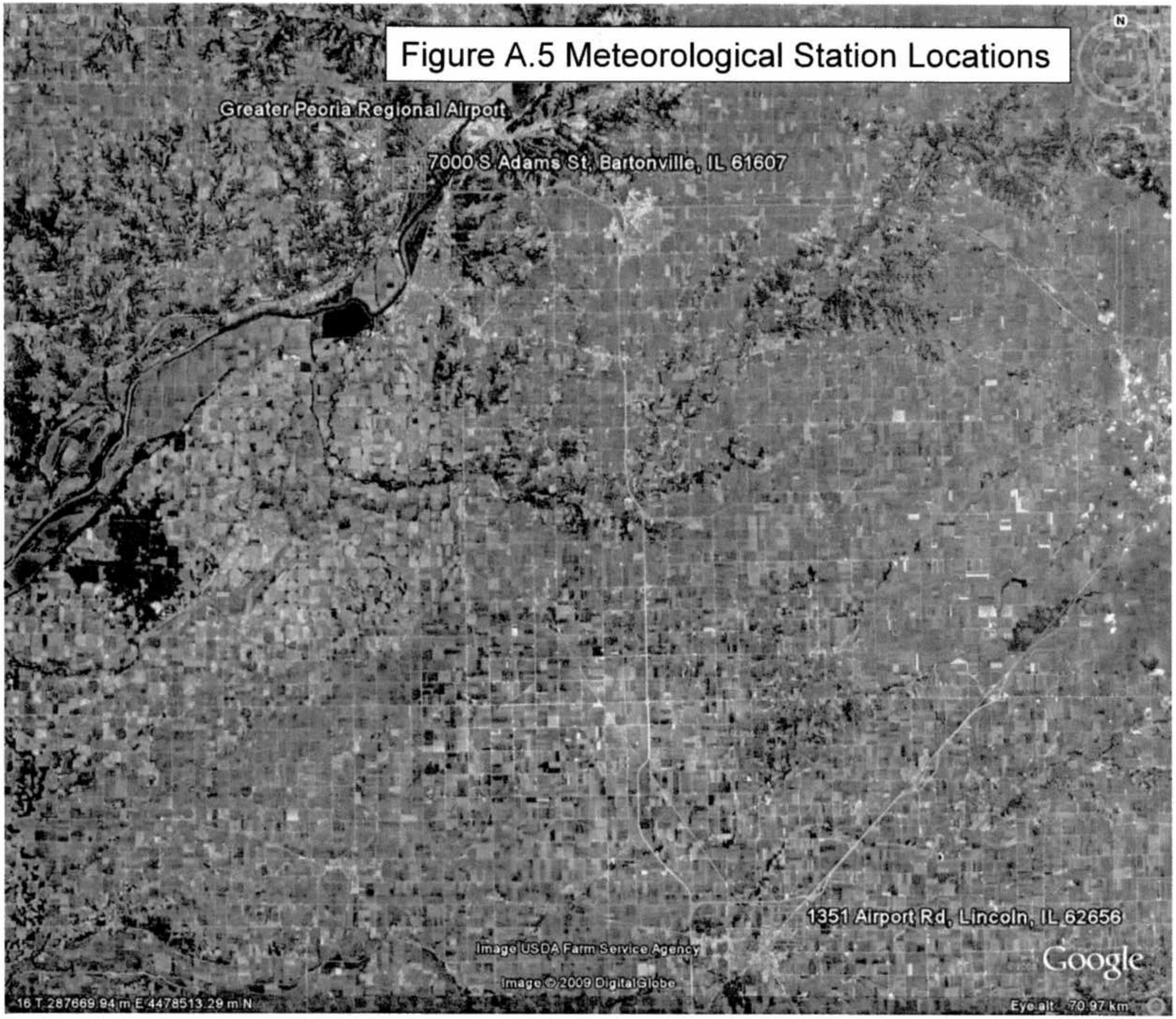
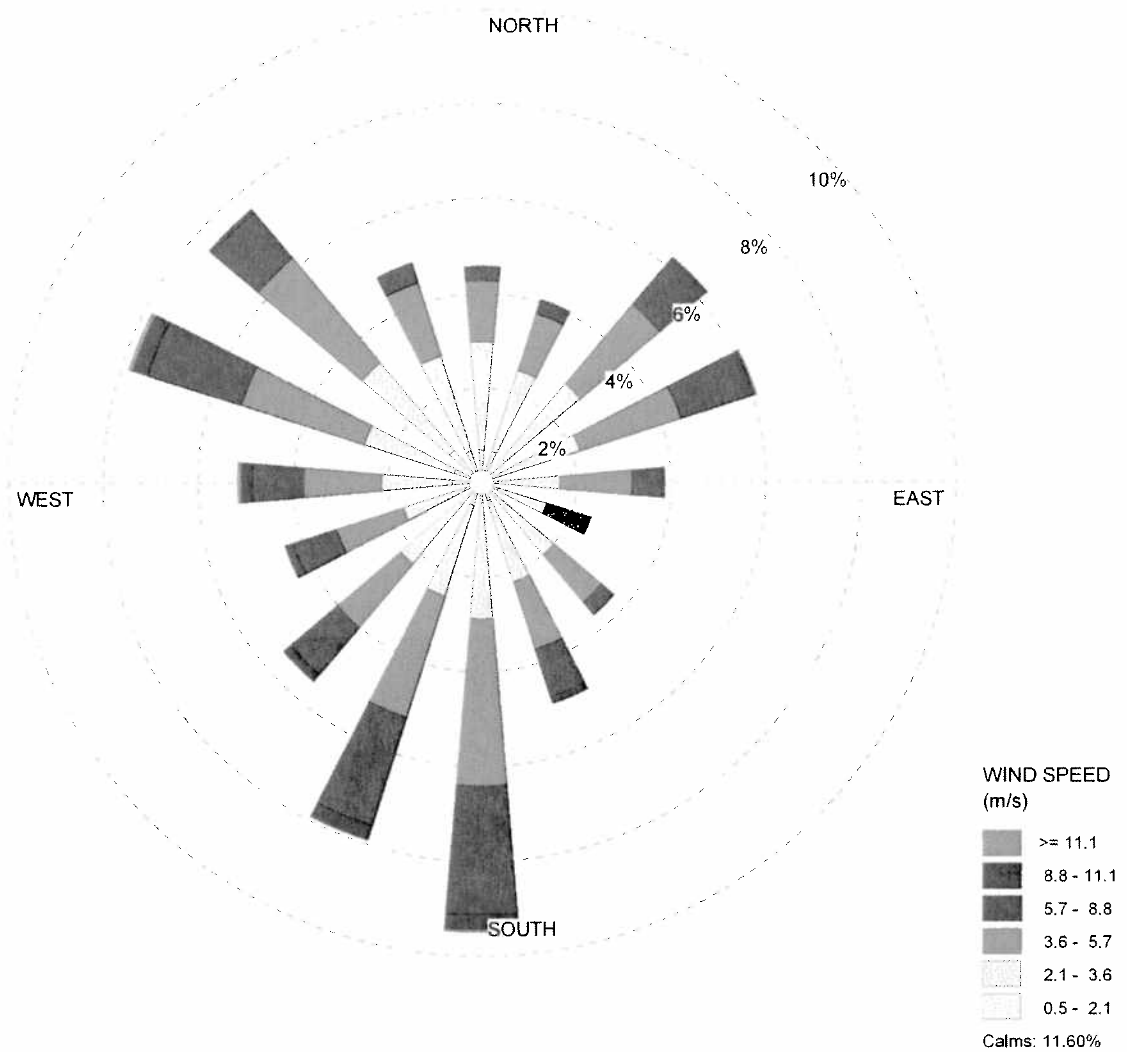


Figure A.5 Meteorological Station Locations
Greater Peoria Regional Airport
7000 S Adams St, Bartonville, IL 61607
1351 Airport Rd, Lincoln, IL 62656
Image USDA Farm Service Agency
Image © 2009 DigitalGlobe
Google
16 T 287669.94 m E 4478513.29 m N
Eye alt 70.97 km

Figure A.6 Wind Rose for 2003

WIND ROSE PLOT:
Keystone PSD Modeling Protocol 2003 Wind Rose
Peoria Greater Airport Station #: 72532

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:
2003
Jan 1 - Dec 31
00:00 - 23:00

COMPANY NAME:
ENVIRON

MODELER:
FDC

TOTAL COUNT:
8736 hrs.

AVG. WIND SPEED:
3.58 m/s

DATE:
2/11/2009

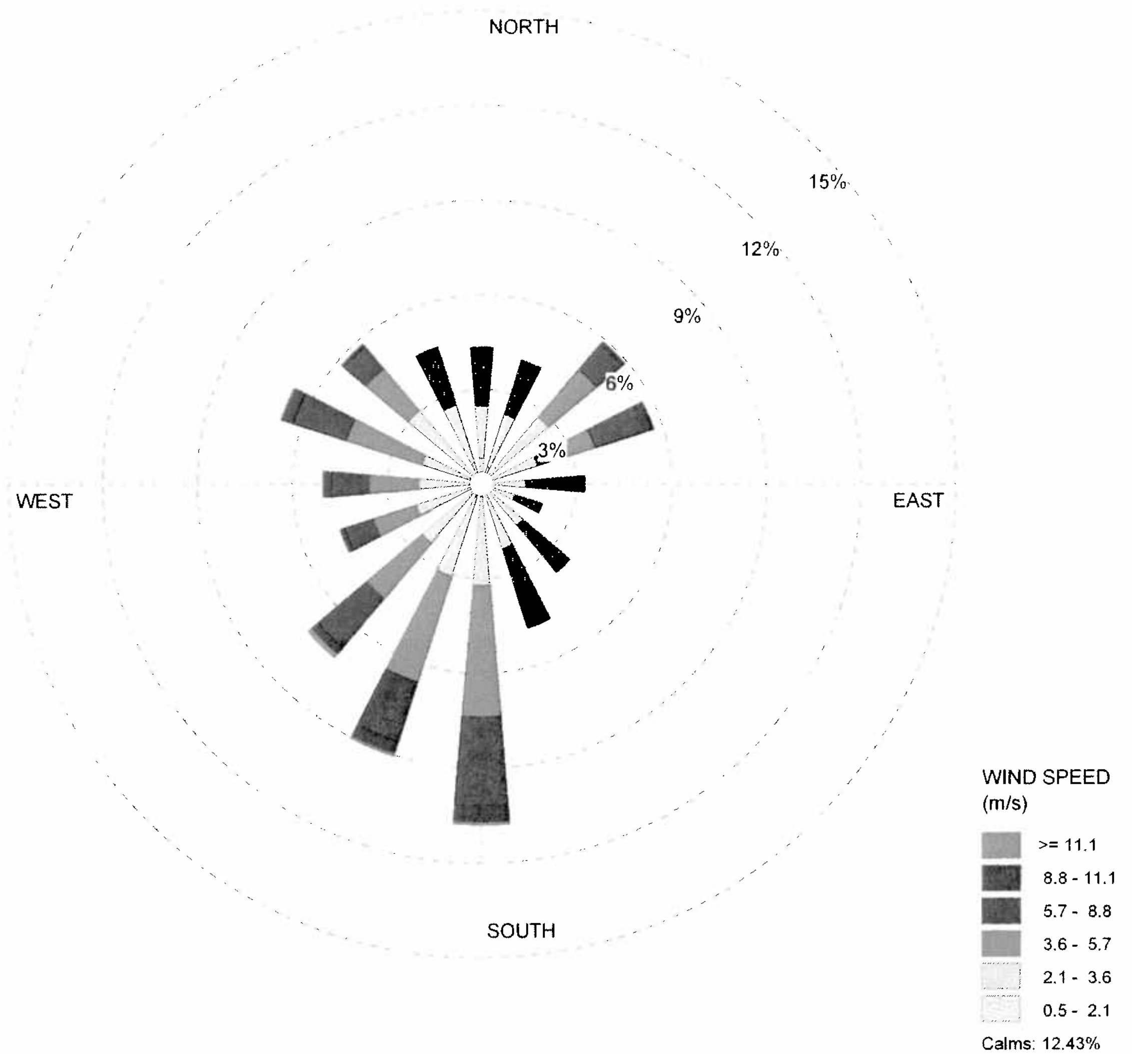
PROJECT NO.:
07-21912A

WRPLOT View - Lakes Environmental Software

Figure A.7 Wind Rose for 2004

WIND ROSE PLOT:
Keystone PSD Modeling Protocol 2004 Wind Rose
Peoria Greater Airport Station #: 72532

DISPLAY:
Wind Speed
Direction (blowing from)

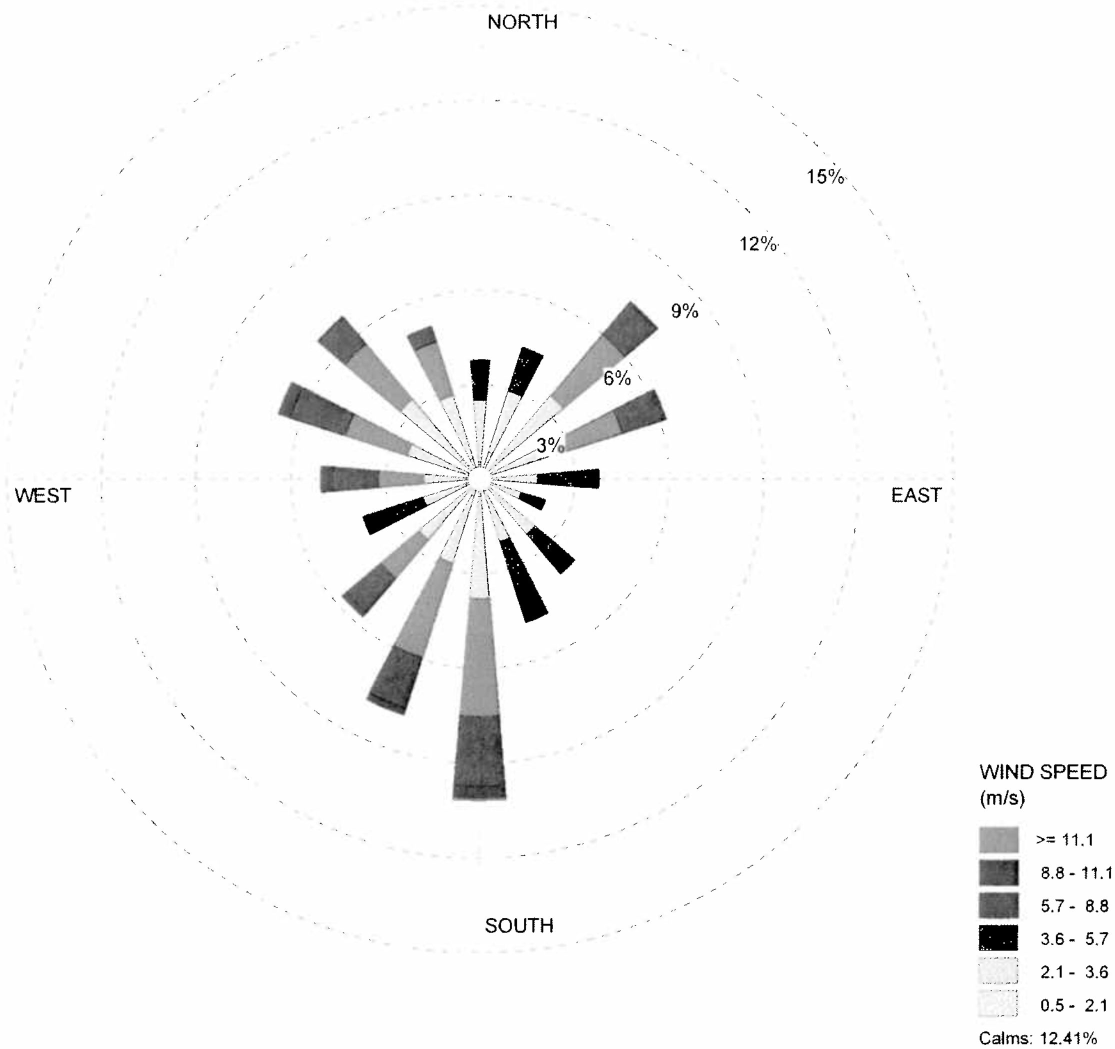


COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2004 **Jan 1 - Dec 31** **00:00 - 23:00**	**ENVIRON**	
		MODELER: **FDC**	
		TOTAL COUNT: **8721 hrs.**	
	AVG. WIND SPEED: **3.63 m/s**	DATE: **2/11/2009**	PROJECT NO.: **07-21912A**

WRPLOT View - Lakes Environmental Software

Figure A.8 Wind Rose for 2005

WIND ROSE PLOT:	DISPLAY:
Keystone PSD Modeling Protocol 2005 Wind Rose **Peoria Greater Airport Station #: 72532**	**Wind Speed** **Direction (blowing from)**



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2005 **Jan 1 - Dec 31** **00:00 - 23:00**	**ENVIRON**	
		MODELER: **FDC**	
		TOTAL COUNT: **8736 hrs.**	
	AVG. WIND SPEED: **3.45 m/s**	DATE: **2/11/2009**	PROJECT NO.: **07-21912A**

WRPLOT View - Lakes Environmental Software

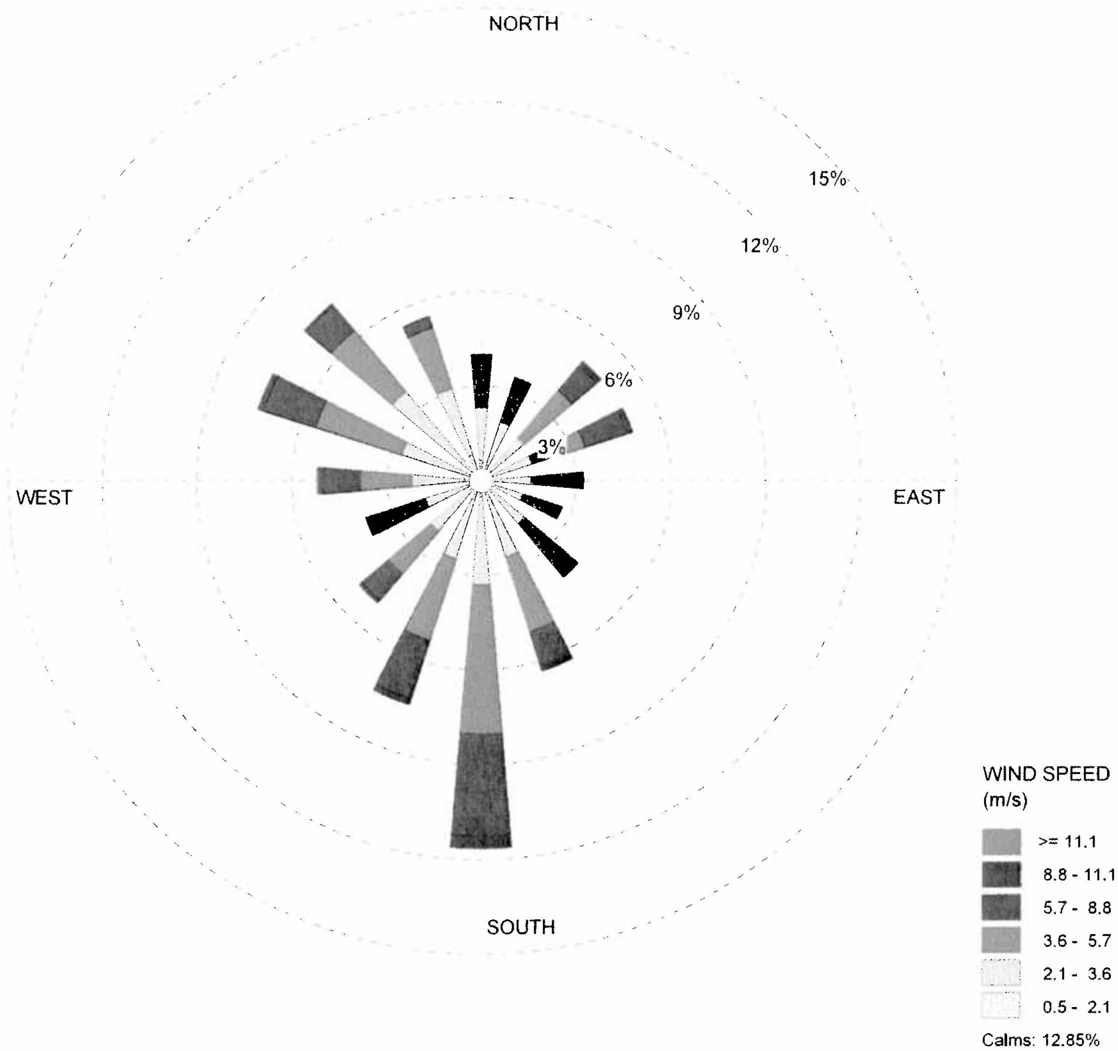
Figure A.9 Wind Rose for 2006

WIND ROSE PLOT:

Keystone PSD Modeling Protocol 2006 Wind Rose
Peoria Greater Airport Station #: 72532

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

DATA PERIOD:

2006
Jan 1 - Dec 31
00:00 - 23:00

COMPANY NAME:

ENVIRON

MODELER:

FDC

TOTAL COUNT:

8736 hrs.

AVG. WIND SPEED:

3.51 m/s

DATE:

2/11/2009

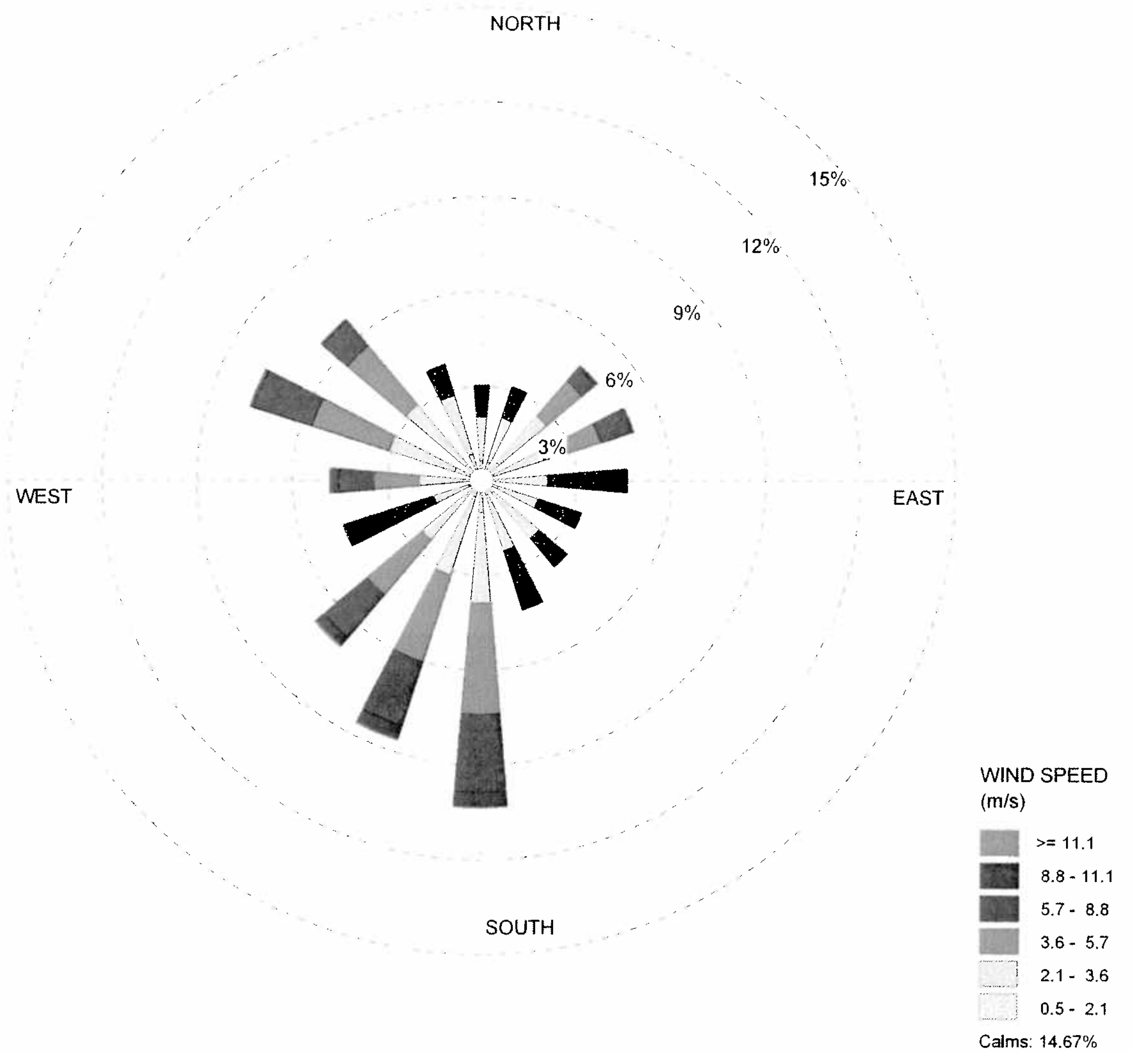
PROJECT NO.:

07-21912A

WRPLOT View - Lakes Environmental Software

Figure A.10 Wind rose for 2007

WIND ROSE PLOT:	DISPLAY:
Keystone PSD Modeling Protocol 2007 Wind Rose **Peoria Greater Airport Station #: 72532**	**Wind Speed** **Direction (blowing from)**



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2007 **Jan 1 - Dec 31** **00:00 - 23:00**	**ENVIRON**	
		MODELER: **FDC**	
		TOTAL COUNT: **8736 hrs.**	
	AVG. WIND SPEED: **3.40 m/s**	DATE: **2/11/2009**	PROJECT NO.: **07-21912A**

WRPLOT View - Lakes Environmental Software